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BRONCHOPNEUMONIA AND ABSCESS SECONDARY TO TONSILLECTOMY *

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Death from bronchopneumonia following tonsillectomy is, fortunately, rare, as shown by Martin,[1] who reports three fatalities in 14,000 operations.

The surgical risk in the first two cases here reported was obviously great, and this clinical study was made with the hope of learning how to lessen this risk. For the sake of brevity, only important and positive findings are recorded.

REPORT OF CASES

CASE 1.—A man, aged 33, married, was admitted to hospital, Oct. 8, 1917. The family history was negative. The patient had recurrent furunculosis and a cardiac murmur since childhood. The murmur may have been due to hemorrhagic chickenpox or to the grip. Syphilis was diagnosed in January, 1917, and mercury and neo-arsphenamin were administered; the Wassermann reaction was weakly positive on October 9.

The patient complained of nervous exhaustion, insufficient sleep, frequent violent headaches, causing intense suffering, and recurring severe epistaxis; in one attack he lost approximately one quart of blood.

Physical examination showed moderate emaciation, hypertrophy and dilatation of the heart, aortic and mitral regurgitation, Corrigan's pulse, dilatation of the aortic arch and arteriosclerosis. Cardiac compensation was well maintained. The blood coagulation time was normal; erythrocytes 3,710,000, or 74 per cent.; hemoglobin, 62 per cent.; leukocytes, 5,400; differential leukocyte count was normal. The systolic pressure in the sitting position was 140, diastolic 40, pulse pressure 100. The blood pressure remained unchanged in recumbency and, after ten bending movements, the systolic pressure increased 5 mm. Urinalyses were negative.

Dr. George Fetterolf found the tonsils large, chronically congested, and the seat of a chronic septic process. In consultation, we decided to recommend the removal of the tonsils, despite the large mortality risk, due to a tendency to hemorrhage, cardiovascular disease, syphilis and furunculosis. This decision was also influenced by the frequent, uncontrollable and intensely severe headaches. These facts were placed before the family and, with their consent, the operation was performed by Dr. Fetterolf,[2] on October 15.

* Read by invitation before the American Academy of Ophthalmology and Otolaryngology, Montreal, Canada, September, 1924.

1. Martin, G. Ewart: J. Laryngol., Rhinol. & Otol. **37**:80 (Feb.) 1922.

2. Fetterolf, George: A Case of Post-tonsillectomy Pulmonary Abscess, Laryngoscope **32**:517 (July) 1922.

The removal of the right tonsil, under ether, was followed by hemorrhage lasting for more than three hours, and it was estimated that from four to six pints of blood were lost. The erythrocytes decreased to 2,850,000, or 57 per cent., hemoglobin, 58 per cent. The leukocytes increased to 11,600, chiefly of the polymorphonuclear variety. Later, the leukocytes increased to 12,400, and finally to 18,000 per cubic millimeter.

Before the operation, a statement was made that as the walls of the arteries were diseased, hemorrhage was to be expected, but it was not anticipated that it would be so difficult to control. After the operation, it was suspected that a pulmonary abscess would develop, in consequence of trauma and the prolonged anesthesia necessary to control the hemorrhage.

The third day after operation, the temperature was 100 F., and the improvement was sufficient to permit the patient to return home. On the fourth day, the leukocytes numbered 11,000, the erythrocytes, 2,880,000, or 53 per cent., and the hemoglobin 58 per cent. On the sixth day, the leukocytes were 13,000, the temperature was septic in type, and later reached a maximum of 104.6 F.

The cough, which at first was moderate and dry, later became severe and paroxysmal, and was accompanied by mucopurulent expectoration. Occasionally, the odor of the sputum and breath was putrescent, probably from the sloughing exudate in the tonsillar region, but later, when the throat healed, the putrescence increased from 4 to 8 ounces of sputum, which was highly putrescent and contained many streptococci and capsulated diplococci, but no tubercle bacilli, were expectorated daily. About the seventh day, the physical signs of bronchopneumonia slowly developed in the right margin of the lower lobe of the left lung, and gradually extended, and later an abscess formed. Aspiration of the abscess was advised and performed, with negative results. The patient steadily grew worse, and pulmonary edema caused death forty-two days after the operation.

The necropsy showed pleural adhesions, and a moderate sized irregularly shaped abscess cavity, filled with pus, occupying the lower lobe of the left lung. The lung surrounding the abscess was pneumonic. The aortic leaflets were fibrotic and markedly retracted.

Comment.—This death was due directly to hemorrhage, secondary to syphilitic endarteritis, causing shock and increased susceptibility to the streptococcus in the infected tonsils, the absorption and inspiration of which was favored by prolonged etherization and trauma, necessitated by efforts to control hemorrhage. In a similar case, even though the blood coagulation time is normal, the intravenous use of 10 c.c. of a 10 per cent. solution of calcium chlorid, in redistilled water daily for three days prior to a tonsillectomy, is recommended.

Case 2.—A woman, aged 71, unmarried, was admitted to hospital, Jan. 24, 1921, with a history of constant and severe occipital headache, dyspnea on moderate exertion, which occasionally awakened her from sleep, tremors of the hands and feet, which began two and a half years ago, constipation, occasionally severe shooting pains across the lower precordial region, general weakness, nervousness and distress. She had infantile paralysis at the age of 2, severe nervous breakdowns at the ages of 39 and 70, and six months ago, slight apoplexy or thrombosis. Her suffering was such that she said death was preferable. Examination revealed well marked senility, defective memory and power of concentrating, paroxysmal attacks of cough aggravated by exertion, moderate obesity, chronic myocarditis and degeneration, cardiac decompensation, rhythmic clonic tremors of the hands and feet, extreme weakness, edentulous and exaggerated knee jerks.

Erythrocytes 4,140,000, or 82 per cent., hemoglobin 80 per cent., leukocytes 5,600, polymorphonuclears 57 per cent., large lymphocytes 9.5 per cent., small lymphocytes 33.5 per cent. The anemia, leukopenia and lymphocytosis was believed to be due to the absorption of the toxins or micro-organisms, or both,

from a focus of infection. In the sitting position, the pulse was 92, systolic pressure 170, diastolic pressure 110, which was unchanged by recumbency. Exercise increased the pulse to 116, and caused marked dyspnea. Except for large amounts of indican and skatol, the urine was negative.

Dr. J. Leslie Davis,[3] who has referred to this case in a recent article, reported the tonsils as of moderate size, and markedly septic and, in consultation, we agreed that as no improvement could be expected from medical treatment so long as infection continued, a tonsillectomy should be recommended, despite the great operative risk, due to senility, adynamia, obesity, chronic myocarditis and decompensation, provided the patient's relatives approved after the gravity of the operation had been fully explained.

The operation was performed by Dr. Davis on Feb. 6, 1922, under local anesthesia, the patient having previously received for several days, full doses of the infusion of digitalis and the tincture of nux vomica. Owing to the condition of the tonsils and the weakness of the patient, the operation was prolonged and was followed by considerable shock. During the night following the operation, pulmonary edema and congestion occurred, requiring active stimulation and venesection. On the third day, pneumonia developed in the base of the left lung. On the fifth day, both bases were congested and the entire lower lobe of the left lung was consolidated. The temperature was 104.6 F., respiration 60, pulse 130, cyanosis and delirium were present. Urinalysis disclosed albuminuria, hyaline and granular tube casts. Leukocytosis was also present. Death occurred six days after the operation, before a pulmonary abscess could develop.

Comment.—In similar cases, in the future, the complication of pneumonia or pulmonary abscess may be diminished if antibody resistance is increased by the preoperative use of an autogenous vaccine; by devising a technic by which the duration of the operation and anesthesia is reduced to a minimum, thus lessening shock and the risk of the absorption or aspiration of pathogenic micro-organisms.

Case 3.—A man, aged 61, was seen Dec. 11, 1922.

Past History.—The patient was first seen in 1904, when he was suffering from neurasthenia, intestinal toxemia and partial cardiac decompensation, secondary to chronic valvulitis. The family history revealed nothing of importance, excepting that there were many deaths from heart disease. At the age of 12, the patient had pneumonia which was nearly fatal. At the age of 15, he suffered from recurring attacks of rhinitis. At the age of 25, he had so-called inflammatory rheumatism, affecting the left elbow which was red, swollen and painful. He had been under a series of nervous strains, had overworked more or less continuously and was moderately obese. The teeth showed well marked periapical infection, the removal of which was followed by severe and persistent hemorrhage, and when examined, showed streptococcus.

The tonsils were diagnosed as infective in April, 1922, and the crypts showed *Streptococcus hemolyticus* and *Staphylococcus aureus hemolyticus,* from which a vaccine was made and administered, as the patient declined operation.

Reexamination was made in December, 1922. The pulse in sitting position was 76, systolic pressure 155, diastolic pressure 100, pulse pressure 55, only slightly influenced by recumbency or exercise. Erythrocytes numbered 4,490,000, or 90 per cent., hemoglobin 85 per cent., leukocytes 6,600, polymorphonuclear cells 60.5 per cent., large lymphocytes 8.5 per cent., small lymphocytes 30 per cent., mast cells 1 per cent. The slight reduction in the leukocytes and the increase in the lymphocytes were believed to be due to tonsillar infection.

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3. Davis, J. L.: Tonsillectomy and Anesthesia, Therap. Gaz. **39**:157 (March 15) 1923.

The urine was concentrated, and contained a large amount of indican and oxalate calcium crystals, a few cylindroids, but no albumin or sugar.

The patient complained of weakness, nervousness, numbness of both arms and hands and a slightly enlarged finger joint. The joint of the middle finger of the left hand was not only enlarged but painful.

Cardiac compensation for the old mitral valvulitis was fairly well maintained. The occurrence of arthritis, numbness, slight anemia, leukopenia and lymphocytosis all indicated the entrance into the circulation of toxins or streptococci or both, and the only focus of infection discoverable was the tonsils. The tonsils presented the appearance of two large, spongy masses, each containing foul smelling secretions; material from the crypts contained an almost pure culture of hemolytic streptococci.

Tonsillectomy was performed by Dr. Ross H. Skillern, Jan. 9, 1923; the tonsils being so soft that they could only be removed piecemeal. Hemorrhage was so persistent after the removal of the teeth that it was anticipated hemorrhage would follow the removal of the tonsils, but this did not occur. The patient made good progress until January 13, four days after the operation, when a considerable nasal discharge occurred, accompanied by a rise of temperature to 103 F., pulse 114, respiration 26, and the urine now showed a trace of albumin and granular hyaline tube casts; two days later, the albuminuria and cylindruria increased, due to an acute infective nephritis. The urine also contained a large amount of indican and skatol, indicating intestinal toxemia. On January 14, Dr. Alexander Klein reported that a dry, hacking cough had developed, temperature 102.8 F., pulse 98, respiration 24. The nasal obstruction was well marked and the upper lobe of the right lung showed signs of beginning consolidation. On January 15, the temperature was 104 F., pulse 120, respiration 32; the patient was delirious and the pneumonia had extended to the base of the other lung. On January 17, the temperature was 102 F., the pulse 140, respiration 40, the patient was semiconscious and unable to answer questions. Pulmonary edema was present, the circulation failed rapidly, and death occurred early the following morning, eight days after the operation.

Comment.—The friable condition of the diseased tonsils necessitated removal piecemeal, favoring the absorption and aspiration of streptococci and toxins. The extension of pneumonia from one lung to the other and the acute infective nephritis, suggest virulency of the streptococcus or loss of resistance, or both. The previously damaged cardiovascular system permitted the circulation to yield more easily and favored pulmonary edema.

Although the patient was definitely substandard in health, we did not believe the risk from the tonsillectomy would be great, and the fatal pneumonia was not expected.

It was regrettable that when the diagnosis of infected tonsils was made in May, 1922, the patient did not accept the advice that they be promptly removed.

A review of this case gives no data by which death may be anticipated or prevented under similar circumstances. If the virulency of the streptococcus or the susceptibility of the patient had been determined, perhaps the prognosis would have been less favorable.

COMMENT

The remarks on Case 2 are equally applicable to this case. Many physicians and laryngologists fail to recognize the etiologic relationship of the removal of infected tonsils to pneumonia and pulmonary abscess. Pneumonia and pulmonary abscess follow tonsillectomy more frequently than is generally believed, and may occur one or more weeks after the operation and, in such cases, the causal relation of tonsillectomy is frequently overlooked.

The following suggestions may be of advantage in cases similar to those reported.

CONCLUSIONS

1. The preoperative local treatment of infected tonsils, although unsatisfactory, may give partial good results. The crypts are often occluded by adhesions, and a retrotonsillar abscess cannot be favorably influenced by local treatment; nevertheless, when the mortality risk is high, the crypts should be emptied by mechanical means, especially by suction. The division of the cryptal walls, so as to favor drainage and secure more infected material by suction, and local application of iodin are recommended.

2. The operator should give serious thought to the especial requirements of the individual patient, so far as the anesthetic is concerned, and the operation should be adapted to the peculiar requirements of each case.

3. In suitable cases, the Waring Suction Tube, the Wieder Cup,[4] or the Moore[5] Sump should be of value when the mortality risk from tonsillectomy is large.

4. Teamwork on the part of the surgeon, the assistant, the intern, the anesthetizer and the nurse.

5. The surgeon should confer with the consulting physician before, during and after the operation.

6. Ten cubic centimeters of a 10 per cent. solution of calcium chlorid, in redistilled water, should be given intravenously for three days prior to the operation, even though the blood coagulation time is normal, and is especially indicated in hemorrhagic cases.

7. An autogenous vaccine before the operation will increase antibody resistance, lessen the operative risk and expedite recovery.

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4. Wieder, Henry S.: A Cup Device to Prevent Pneumonia Following Tonsillectomy, by the Sluder Technic, Eye, Ear, Nose & Throat Monthly, (Jan.) 1924.

5. Moore, William Frederick: Tonsillectomy Sump, Laryngoscope **32**:692 (Sept.) 1922.

8. Senile, asthenic and cardiac patients should receive the infusion or tincture of digitalis, tincture of nux vomica and whisky, for one week before and after the operation.

9. In the postoperative period, rest in bed and the judicious use of morphin, atrophin, whisky, digitalis, nux vomica and laxatives are indicated.

10. The patient should rest on the side, with the head turned so as to facilitate the escape of saliva and blood. Hawking, clearing the throat and talking should be avoided.

LUNG ABSCESS FOLLOWING TONSILLECTOMY

A CONTRIBUTION TO THE ETIOLOGY *

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A great deal of reflection and study has been devoted to the subject of lung abscess following tonsillectomy. At the present time there are two main theories of its origin. One is that the lung suppuration is usually due to the aspiration of adenoid or tonsil tissue, or of potentially infective blood and mucus, or the crypt content or any combination of these. The other is that a septic embolus becomes dislodged from one of the thrombosed vessels in the operative area, and finally settles in the lung where an abscess is initiated.

SYMPTOMS

We are all acquainted with the symptomatology of lung abscess following tonsillectomy. Briefly it is this: The patient may recall that immediately after operation he did not feel very well; or he may have felt perfectly well until the sixth to the fourteenth day, when he had a sudden pain in the chest and began to cough and expectorate a varying amount of foul smelling sputum.

REVIEW OF THE LITERATURE

The literature has been reviewed so frequently of late that a general review here will be omitted. Up to the present date sufficient work has been done to justify the opinion that aspiration is probably the most frequent route, while the blood stream is admitted to be a possibility and therefore only occasionally the avenue of infection.

If lung abscesses occurred in the manner claimed by the proponents of the aspiration theory, it should follow that all these suppurations would communicate with the bronchial tree. It was reasoned that if post-tonsillectomy abscesses were encountered which did not communicate with the bronchi, we would have a very strong case against aspiration. I therefore communicated with several workers who were particularly interested in these lung suppurations, requesting information as to whether the person addressed had ever encountered a lung abscess following tonsillectomy which did not communicate with the bronchial tree.

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* Department of Laryngology, Kings County Hospital, service of Dr. Hubert Arrowsmith.

* Candidate's Thesis, American Bronchoscopic Association, June, 1924.

Hedblom [1] could not state definitely whether these abscesses communicated with the tracheobronchial tree at their inceptions; he said:

It is my impression that all of the patients with pulmonary suppurations following tonsillectomy, who have been observed at the Mayo Clinic, were draining through the bronchi at the time they came here.

Lilienthal [2] had the following to say:

I do not know of a single infection following tonsillectomy in which an extra bronchial infection was shown to have antedated the pulmonary suppuration. I believe that these cases are practically all aspiration ones, but I can understand that lung infection by way of the veins could occur. However, in this case the almost uniform observation of the suppurative process beginning in one lobe though later extending, is not easy to explain. Infection through a vein to the right heart would naturally lead to multiple minute emboli by way of the blood stream.

In this communication Lilienthal states the position of the majority of investigators on this subject, that practically all are cases for aspiration, but that there is a possibility of the abscess being due to embolism.

Tewksbury [3] writes that he has seen one abscess after tonsillectomy that did not communicate with a bronchus. He gives no details and does not mention the duration of the abscess, which is very important in the consideration of this phase of the subject. In a large experience with this type of case, he has encountered one abscess not communicating with a bronchus. If we accept this as a nonaspiration abscess, Tewksbury's experience would substantiate the position of the aspiration school, which admits that an embolic abscess may rarely occur.

Wessler [4] writes:

I have not seen any cases of extra bronchial abscess following tonsillectomy. I have always regarded such abscesses as aspiration in origin and therefore arising from within the bronchial tree. If any of them have another origin, I really should not know how to demonstrate the fact.

Here we have a strong supporter of the aspiration theory, from one who has had considerable experience with cases of the type under discussion.

Whittemore [5] states the following:

I believe that an abscess of the lung following tonsillectomy is due to the direct aspiration of septic material during the operation or while the patient is still under the influence of the anesthetic. I have never seen a case following tonsillectomy that did not communicate with the bronchial tree.

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1. Hedblom, C. A.: Personal communication to the author.
2. Lilienthal, Howard: Personal communication to the author.
3. Tewksbury, W. D.: Personal communication to the author.
4. Wessler, H.: Personal communication to the author.
5. Whittemore, Wyman: Personal communication to the author.

Cutler [6] writes:

> I have never know a post-tonsillectomy suppuration that did not communicate with the bronchial tree. I believe the etiology lies in a metastatic transfer of infection via either the blood stream or lymphatics. It is in that sense embolic and not aspiration. As a proof of this, I state the fact that cases have been reported where lung abscess has occurred, following tonsillectomy under local anesthesia.

Cutler has been studying postoperative pulmonary complications for a long time and is strongly in favor of the embolic theory. (The question of lung suppuration following tonsillectomy under local anesthesia will be commented on later.)

The following from Porter,[7] whose article in 1921 [8] gave the embolic theory considerable support and impetus, is of interest. He says:

> I feel that there is no doubt about the fact that aspiration is the most important cause of the large single abscess, which has associated with it pulmonary gangrene. I do believe though, that certain abscesses are the result of infected emboli. This, I believe is a relatively rare cause of the condition.
>
> I have had during the past two years sixteen cases of embolic pneumonia which occurred in cases which had septic wounds in the abdomen, head and extremities. But only one developed what appeared to be a pulmonary abscess. Undoubtedly something happens to an embolus in its course which attenuates the virulence of the harbored organisms. These cases as a rule have a rather stormy course for twenty-four hours, and usually in from forty-eight to seventy-two hours their temperatures are normal, and from that point on their convalescence is uninterrupted.

Porter is good enough to admit that his ideas have changed since 1921, and furnishes us with an instructive experience with pulmonary complications, due to blood stream infection from a septic operative field.

Until the present time considerable stress has been laid on the position of the patient, the type of instrumentation, the type and application of suction, hemorrhage, vomiting and other factors incidental to the operation of tonsillectomy and adenoidectomy. In recent bronchoscopic studies of tonsillectomy under general anesthesia, which comprised two series of 100 cases each, where every precaution known was observed, seventy-nine of the first 100 [9] showed the presence of blood in the tracheobronchial tree, while in the second series [10] seventy-six showed the same picture in the pulmonary tract.

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6. Cutler, Elliott C.: Personal communication to the author.

7. Porter, W. B.: Personal communication to the author.

8. Porter, W. B.: Pulmonary Abscess Following Tonsillectomy Under Local Anesthesia, Virginia M. Monthly **47**:606 (March) 1921.

9. Myerson, M. C.: Pulmonary Aspects of Tonsillectomy Under General Anesthesia, Laryngoscope **32**:929 (Dec.) 1922.

10. Myerson, M. C.: Bronchoscopic Observations on the Cough Reflex in Tonsillectomy Under General Anesthesia, Laryngoscope **34**:63 (Jan.) 1924.

The impression seems to be that the aspiration of blood, mucus and crypt content means pulmonary complications. That this is erroneous was proved in the foregoing studies, where 155 of 200 patients showed the presence of the tonsillectomy blood mixture in the bronchi, yet not a single pulmonary complication occurred. From this we must conclude that the cause of these complications does not lie in the aspiration of the tonsillectomy pharyngeal content into the bronchial tree, or the factors that influence this aspiration, but rather in the failure of the evacuation of this potentially infective material and the factors that influence this failure of evacuation and expulsion from the bronchial tree and lung bed.

It must be admitted that a normal lung bed and bronchial tree would indicate a normal expulsion effort. In the consideration of the normal mechanism of impelling secretions through the various elements of the pulmonary tract, the first place must be given to the cilia. It was demonstrated by Bullowa and Gottlieb [11] that a barium capsule or mixture will not be expelled in the presence of destruction of, or injury to, the epithelial lining of the bronchus. From our observations while treating lung abscesses bronchoscopically, it is clearly evident that stasis of the abscess content occurs because of ciliary destruction. In many cases that alone could account for the failure of evacuation. I refer to the comparatively small cavities of short duration, which should evacuate readily if the cilia in the emptying bronchioles were functioning.

Next to the cilia the elasticity and compressibility of the lung tissue engages our attention. This elasticity and compressibility, when unimpaired, help to impel fluid content into the bronchioles for further expulsion. Extensive fibrotic lesions within the parenchyma itself or a healed pleurisy will account for a local immobility of the lung tissue, with resulting stasis of aspirated content.

THE PERISTALTIC WAVE

Bullowa and Gottlieb [12] have reported what they have interpreted as a peristaltic muscular wave of the trachea and larger bronchi in anesthetized dogs. They contend that this peristaltic muscular wave must play an important rôle in the expulsion of secretions from the respiratory tract. I have looked repeatedly for this peristaltic wave bronchoscopically but have never observed it. The impression of a peristaltic wave derived from a roentgen-ray study of anesthetized dogs, the bronchial trees of which were injected with a barium mixture, might be

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11. Bullowa, J. G. M., and Gottlieb, C.: Roentgen-Ray Studies of Bronchial Function, Am. J. M. Sc. **160**:98 (July) 1920.

12. Bullowa, J. G. M., and Gottlieb, C.: Additional Experimental Studies in Bronchial Function, Laryngoscope **32**:284 (April) 1922.

erroneous. It is well known that there is a shortening of the bronchial tubes on inspiration and an elongation of the tubes on expiration. The impressions recorded fluoroscopically and by roentgen-ray plates might readily be construed as due to a peristaltic wave, but when one considers that an anesthetized animal breathes at the rate of 30 or more per minute, the impression of a peristaltic wave is readily explained. Therefore I do not feel that I can consider a peristaltic wave as playing any part in the expulsion of pulmonary tract content.[12a]

To the foregoing factors might probably be added the presence of alveolar lymph channels, the function of which it is to absorb to some extent fluids that may reach the lung bed.

One need only visualize a fibrosed or calcified tuberculous lesion or a healed fibrotic pneumonia area, or a postinfluenzal fibrosis, to understand that none of the factors before mentioned could function in the presence of such a lesion. The greater frequency of lung abscess in the last few years may well be attributed to the increased prevalence of influenza, which is notoriously harmful to lung tissue. The literature abounds in articles which deal with postinfluenzal sequelae in the lung. Fishberg [13] emphasizes the frequent localization of these healed lesions in the lower lobes. It is probably these healed lesions in the lower lobes that account for the frequency of post-tonsillectomy abscesses locating there rather than the mere fact of aspiration as claimed by Moore.[14] If we could establish the previous history of influenza in our abscess patients, this condition could be proved, as an important etiologic factor, but because of the variety of names an attack of influenza is given, and because frequently the patient does not take the influenza seriously enough to remember it, we are greatly handicapped in establishing this point.

LUNG DISEASES

Certain diseases of the lung parenchyma and finer tubes will call forth a replacement fibrosis. These are principally tuberculosis and influenza, occasionally pneumonia. It is also accepted that tuberculous lesions exist unrecognized both by the patient and his physician in a large percentage of the adult population. It is a significant fact that a

12A. Conversation with one of the observers of this phenomenon, since this paper was submitted, has led me to believe that there probably is such a phenomenon. It remains, however, for substantiating and corroborative experimentation to establish the existence of a peristaltic wave as a part of the expelling force of the lung.

13. Fishberg, M.: Pulmonary Sequels of Influenza, Am. J. M. Sc. **161**:365 (March) 1921.

14. Moore, W. F.: Pulmonary Abscess. An Analysis of Two Hundred and Two Cases Following Operative Work About the Upper Respiratory Passages, J. A. M. A. **78**:1279 (April 29) 1922.

very high percentage of lung abscesses following tonsillectomy occur in adults who would more likely possess the lung changes under discussion.

It is these fibrotic changes that engage our attention as the main contributing factor in the production of suppurative lesions in the lung as a sequel to tonsillectomy. When the fibrosis is so situated in its relation to the bronchial tree that it can receive the tonsillectomy mixture, we have the stage set for a potential abscess.

The little pathology [15] that is known of tonsillectomy lung abscesses would indicate that they are principally of the bronchiectatic type, with a secondary suppurative pneumonitis. This leads to the deduction that tissue, crypt content or blood mixture enter a smaller bronchial element and cause certain changes to ensue. This content would be expelled in a very short period of time if the ciliary action and the compressibility of the adjacent lung structures were unimpaired. But it would appear that sufficient damage has been done to the tube and the surrounding tissue to impair or prevent expulsion. It is the lack of the expulsive elements that permits aspirated material to remain in the smaller bronchial element and adjacent structure until decomposition, infection and putrefaction take place. One might argue that the patient should cough and expel this content. In a consideration of the mechanism of cough, Rohrer [16] says:

> It is improbable that the mechanical force of coughing can impel secretions in the narrow bronchi; even fluid secretion develops too high an internal resistance to friction in comparison to the pressure of pulmonary air in coughing. Except for the water secretion in pulmonary edema, all the secretions in the narrower bronchi are not impelled by coughing, but by the ciliary movement of the individual cells.

So that from the foregoing, coughing is a negligible factor in the expulsion of content from the smaller bronchial elements.

Defective lung tissue and hampered expulsion apparatus must hold the first place in the production of suppurations following tonsillectomy. The following experiments carried out at the laboratories of Mount Sinai Hospital and reported by Aschner [17] support this contention:

> Efforts to duplicate bronchiectatic abscess processes in dogs by means of intratracheal insufflation of pieces of tonsil and adenoid, pus from clinical cases, and cultures of anaerobes have been unsuccessful. Blood aspirated from the femoral vein was injected with tonsil tissue and anaerobes without producing suppuration.

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15. Aschner, P. W.: The Pathology of Lung Suppuration, Ann. Surg. **75**:321 (March) 1922.

16. Rohrer, F.: Die mechanik des Hustens, Schweiz. med. Wchnschr. **51**: 765 (Aug. 18) 1921.

17. Aschner, P. W.: Footnote 15.

I would venture the suggestion that if the mucosa of one of the smaller bronchial tubes had been damaged or destroyed, an abscess would have supervened. For the destruction of the cilia in that region would have prevented expulsion of the material introduced.

TUBERCULOSIS

In the discussion of 202 lung abscesses occurring in approximately 400,000 tonsillectomies which his questionnaire uncovered, Moore [18] brought out the fact that a great many of these patients had had tuberculosis preexisting or established before operation and later developed lung abscess. Thirty-nine of his patients had known pulmonary lesions, thirty-three of which were due to tuberculosis.

Simpson and Noah [19] report two cases of lung abscess following tonsillectomy under local anesthesia in tuberculous subjects. Porter [8] also reports two cases of lung abscess following operation under local anesthesia, but does not mention preexisting pulmonary pathology. Several writers are of the opinion that the only manner in which lung abscess could occur after the local anesthesia operation is by the embolic route. It is a mistaken assumption that aspiration does not occur during the local anesthesia procedure. Most of us who have performed these operations under local anesthesia, and especially where we have used cocain solution for swabbing the throat, have encountered evidence of aspiration of blood during the operation. I remember distinctly three cases in which I used cocain solution for swabbing before procain infiltration, where I observed the coughing up of blood and mucus while the patient was in the chair.

ANESTHESIA

A factor that has been given little or no attention in previous discussions of this subject is the prolonged administration of ether and its concentration. McDowell [20] mentions the possibility of actual death of tissue in the lung as a result of deep or prolonged anesthesia with ether. In the complete report of a case of lung abscess following tonsillectomy, Fetterolf [21] stresses the prolonged anesthesia and severe homorrhage, with their possibilities of inhalation of septic material, which could cause irritation and infection of the lung tissue.

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18. Moore, W. F.: Footnote 14.

19. Simpson, J. R., and Noah, H. G.: Report of Two Cases of Lung Abscess Following Tonsillectomy Under Local Anesthesia in Tubercular Subjects, Pennsylvania M. J. **23**:332 (March) 1920.

20. McDowell, R. J. S.: Effects of Anesthetics on Lungs, Brit. M. J. **1**:61 (Jan. 13) 1923.

21. Fetterolf, G.: A Case of Post Tonsillectomy Pulmonary Abscess, Laryngoscope **32**:517 (July) 1922.

The following patient, who came under my care for bronchoscopic treatment, is cited to demonstrate the danger of prolonged etherization in tonsillectomy.

REPORT OF CASE

M. H., a woman, white, aged 30, with no history of previous illness that might influence the pulmonary tract, was operated on and kept under the anesthetic for one hour and forty minutes. Clinical signs of an abscess developed on the twelfth day postoperative.

Loss of elasticity as a result of a temporary injury, such as is due to prolonged and concentrated anesthesia, or a permanent change such as fibrosis due to postinfluenzal, postpneumonic or tuberculous pathology, is the basis for future or potential lung abscesses. This is so whether a tonsillectomy or a tooth extraction is performed, or whether the patient contracts an illness such as pneumonia or influenza of a severe type. In tonsillectomy, the operation supplies the medium which finds its way down to the area of nonexpulsion; this medium is usually infected blood and mucus, or at times even pure pus in varying quantity. In the latter type of case where an acute pulmonary disease is present, the exudate is retained, becomes reinfected, and a local acute abscess is initiated.

PULMONARY EMBOLISM

That pulmonary embolism following tonsillectomy is a possibility, but of very rare occurrence, is my conviction.

Fetterolf and Fox,[22] in a comprehensive study of the paratonsillar tissue changes following tonsillectomy, demonstrated that thrombi exist in the veins of the tonsillar fossa and that these thrombi may frequently be septic. They believe that as:

> Trauma, sepsis and muscular action are the principal factors in the formation and dislodgement of thrombi, the actively muscular pharynx is a particularly favorable region for the dislodgement of such thrombi into the superior caval circulation.

I am in perfect accord with all of the foregoing, but call attention to the fact that thrombosis of vessels follows every operative procedure without regard to the region involved. This is one of the fundamentals of pathology. If lung abscess follows tonsillectomy by the embolic route, we should certainly see more lung abscesses following appendectomies and other major operative procedures on structures which are acutely or chronically septic, and which are traumatized and are motile. The pulmonary complications following major operative procedures have received careful study by Cutler and Hunt [23] and numerous other

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22. Fetterolf, G., and Fox, H.: The Reaction of the Paratonsillar Tissues to Tonsillectomy, Am. J. M. Sc. **166**:802 (Dec.) 1923.

23. Cutler, Elliott C., and Hunt, Alice M.: Postoperative Pulmonary Complications, Arch. Int. Med. **29**:449 (April) 1922.

workers. These complications are considered in a majority of cases to be due to embolism from the operative field. To quote Cutler and Hunt:

> The result is pulmonary infarction or fatal pulmonary embolism. The latter is a rapidly fatal, well recognized clinical picture. (This type has not been recorded as following tonsillectomy, so far as I can ascertain.) The former is caused by the transmission to the lung of a small thrombus or many thrombi with resultant characteristic clinical picture. This consists of sudden pain, expectoration, often blood tinged, the elevation of the respiration and pulse rates and temperature, and the signs of a focal consolidation often overlaid by a friction rub. These patches are demonstrable by the roentgen ray, provided such studies are made at once. Rapid defervescence and the subsidence of all symptoms within a week usually follow. The causes of infarction are (1) trauma; (2) the mobility of the part; (3) sepsis. The prognosis in this group is excellent.

Neither of these types of pulmonary complication is recognized by the laryngologist as following tonsillectomy. No mention is made of embolic lung abscess in this study, which includes sixty-three pulmonary complications incidental to 1,604 operations. They explain the absence of abscess on a basis of the absence of septic embolus. They contend that when septic embolism is present, the clinical picture may simulate pneumonia or lung abscess may result, but when the clot is sterile, the resultant changes are characteristic of minor pulmonary infarction.

COMMENT

The inference to be drawn from the foregoing is that septic emboli should enter the pulmonary circulation very frequently following tonsillectomy. All postoperative tonsillectomy wounds are conceded to be infected, which means that a sterile thrombus coming from a tonsillar wound is hardly possible. We should therefore have a much greater frequency of lung abscess following tonsillectomy than one in 2,500 (Moore);[24] or even one in 781 (Keiper,[25] source of figures not stated) if this were the mechanism of causation.

SUMMARY

It is not the aspiration of tonsillectomy mixture that is important in the production of lung abscess following tonsillectomy, but the failure of a given portion of the lung to expel the content that is aspirated.

A normal lung bed and bronchial tree would indicate a normal expulsion force.

Lung tissue and smaller bronchial elements temporarily damaged by increased concentration and prolonged administration of ether, or permanently damaged by influenza, pneumonia or tuberculosis, indicate

24. Moore, W. F.: Footnote 14.
25. Keiper, G. F.: The Tonsil Question up to Date, Laryngoscope **31**:777 (Oct.) 1921.

an inability to expel aspirated material. This involved area becomes the site of election of a suppurative lesion.

This study indicates that all tonsillectomy patients should be given a careful preoperative survey, with special reference to the pulmonary tract. More accurate and complete histories should be taken in these patients, to rule out previous pulmonary disease. Physical examinations should be performed as a routine. It should always be our aim to avoid the distressing complication of lung abscess. In the presence of known pulmonary disease, we should be forewarned and plan our operative procedure accordingly.

THE DIAGNOSTIC SIGNIFICANCE OF AUDIOMETER CURVES

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Audiometer curves, fields of hearing, audiograms and other types of charts illustrating in empirical or absolute values the power of hearing, are being discussed more and more frequently in the current journals. Interest in these records is by no means confined to the physiologist and psychologist who are interested in the solution of the problem of "how we hear," but physicists and engineers, railroads, the air service and other types of corporations are forced by necessity to take cognizance of such measurements in making adjustments for their special services. However, the greatest interest in these records and the keenest scrutiny of their context is undoubtedly being shown by otologists. In France, England, Italy and Germany we note that the members of this profession are becoming more interested, not only from the point of view of determining the effects of operative procedure or treatment, but more especially from that of diagnosis.

THE CLINICAL ASPECT

From the clinical aspect, the importance of accurate diagnosis is self evident. The inaccessibility of the inner ear and the lack of authoritative information concerning its manner of functioning, combined with its vital importance to the physical and social being, makes any additional information concerning its action under normal or pathologic conditions of vital importance to the diagnostician.

It is not contended that the diagnosis of a pathologic condition in the ear can be reached on the basis of a curve of hearing alone. It is not conceivable that a diagnostician would arrive at a conclusion on the basis of any single test. His skill depends on his ability to consider the evidence presented by various examinations in the light of his knowledge and experience.

On the other hand, where evidence of involvement of the cochlear apparatus and its nerve is largely obtained on the basis of hearing tests, the value of these curves becomes self-evident. It matters little how they are secured, whether it is by tuning forks or by audiometers. The sole requirement must be completeness and accuracy. Bezold, the master diagnostician of his age, stresses this point by the statement: "We have therefore completely examined the hearing, as soon as we know quantitatively the hearing for all tones."

LITERATURE

The fathers of otology have handed down a mass of evidence based on careful observation and experiment, which is regarded as basic by present-day diagnosticians. Concerning the value of hearing tests, this is illustrated in one of the late textbooks as follows:

> In the elevation of the lower tone limit or impaired audition for the lower musical tones, then, we have the first functional change which is characteristic of disease of the sound conducting apparatus.[1]

And again:

> While not necessarily or invariably present, diminution or loss of hearing for the extreme of the musical scale occurs with sufficient regularity in diseases of the labyrinth or auditory nerve, to justify a diagnosis of labyrinthine involvement in a majority of cases.
>
> It is a fact which clinical experience has abundantly confirmed, that with acquired lesions of the inner ear some loss of hearing for the upper end of the musical scale is almost invariably present.

Phillips [2] says:

> The hearing function may become defective either in the lower tones, or, per contra, the higher, or, for that matter, in isolated sections of the scale. Hence it becomes important to record in each instance that portion of the musical scale which has become impaired or defective as the result of disease.

Present-day diagnosticians, as well as the older writers, do not show uniformity of procedure relative to the number of tones which shall be used in routine tests of audition. Bezold's charts show that he used eleven forks, supplemented with the Galton whistle for the upper limit measurement, but thinks that "there are only the patients with the highest degree of deafness which require an examination of the whole sound scale." A late text [2] states that: For ordinary diagnostic purposes in testing the perception for the middle, the upper and lower tones, at least three tuning forks, c, c^2 and c^4 should be employed in each individual case. An audiometer [3] recently placed on the market provides for the testing of eight octaves from 64 double vibrations to 8,192 double vibrations.

Whether there is any justification in testing the hearing for a large number of tones seems to be a matter in which there is no general agreement. It is evident, however, that should such tests add information which will aid materially in making a diagnosis, the value of these tests should depend primarily on the amount of information they present.

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1. Kerrison: Diseases of the Ear, Philadelphia, J. B. Lippincott Company, 1921.

2. Phillips: Diseases of the Ear, Nose and Throat, Philadelphia, F. A. Davis Company, 1922.

3. Western Electric Company, Audiometer No. 2A.

More than this, the ease and accuracy with which such tests can be made should receive secondary consideration.

In the Otological Clinic of the University Hospital, the use of the pitch range audiometer in making functional tests of hearing has been subjected to the keenest scrutiny. When the instrument was first presented (1919), it was used only as accessory to the other tests. Later,

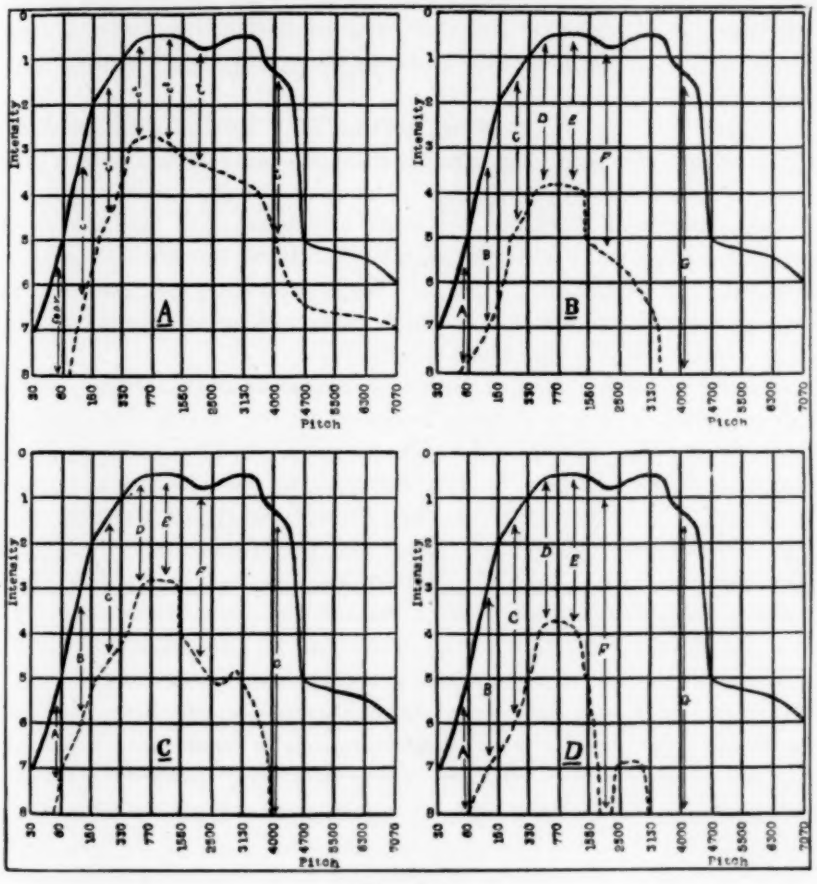

Figure 1

on account of the ease, accuracy and thoroughness with which records could be secured with the instrument, it was accepted as routine for all cases requiring the functional tests of hearing. Papers [4] presented heretofore have explained the mechanical details of the instrument. Here only the diagnostic significance of the curves will be noted. The

4. Bunch, C. C.: New Procedure in Tests of Auditory Acuity, J. Opt. Soc. Am. & Rev. Sc. Inst., 1923, p. 1161.

subjects presented were all examined in the Otological Clinic of the University Hospital, and the diagnosis was given by Dr. L. W. Dean or his assistants.

SIGNIFICANCE OF THE CURVES

Figure 1,[5] *A*, is the curve given by an ear, diagnosed as chronic hyperplastic otitis media. The tuning fork tests in this case show a uniformly marked loss of sensitivity for the seven octaves (50 double vibrations, c, c^1, c^2, c^3, c^4 and c^5). The corresponding pitches on the curve show a uniform decrease from the normal of approximately three steps.

Figure 1, *B*, is the curve of hearing of a patient with the same clinical diagnosis as the preceding one. The tuning fork results in the two cases were very much alike. The curve reveals plainly that the deafness increases gradually for tones of higher pitch, the loss at *A* being two steps while at *G* the sound from the audiometer is inaudible at its maximum intensity. The loss for low tones is combined in this case with a much greater loss for high tones, giving the classical picture of a combined middle and inner ear lesion.

Figure 1, *C*, is a case of chronic suppurative otitis media. It will be noted that the loss of hearing indicated on the vertical lines lettered A, B, C, D and E appears to be quite uniform, the decrease being about two and one-half steps. At F it increases to four steps and at G it becomes seven. Cases B and C then present the typical evidence of a combined lesion of the middle and inner ears, the deafness due to the latter being the more marked. The tuning fork tests in all three cases revealed in perhaps a less striking manner the same information. If, however, we compare these three curves with *D*, also diagnosed chronic hyperplastic otitis media, and having tuning fork results similar to the first three cases, we note first of all a complete gap between 2,000 double vibrations and 2,300 double vibrations, a condition not appearing in the other three. This, according to Lucae,[6] localizes the lesion more strongly in the labyrinth. It would appear from these examples that the demonstration of the absence of tonal gaps in the first three cases is a point as essential in diagnosis as is that of showing their presence. Evidence for diagnosis need not be positive. It is in the

5. In the audiometer curves presented, the intensities are indicated on the vertical lines and the pitch on the horizontal. Normally no sound is audible on step *O*. The intensity of each succeeding step is increased by the addition of 400 per cent. to the resistance of a potentiometer in parallel with the telephone receiver of the audiometer. The unbroken black line is that for normal hearing, and the curve for the right is represented by a line of dashes and that for the left by dots.

6. "The presence of islets and gaps in the tone scale can only be referred to disease of the labyrinth" (Deutsch. med. Wchnschr., 1906, No. 9; abstr. Arch. Otol., 1907, p. 157).

differentiation between "positive" and "negative" that diagnosis is made definite.

The frequent occurrence of certain types of curves often leads one to feel that the formation of a diagnosis on the basis of the audiometer test alone is a possibility. This has often proved fallacious. While the classical functional diagnostic points hold true in the main, exceptions

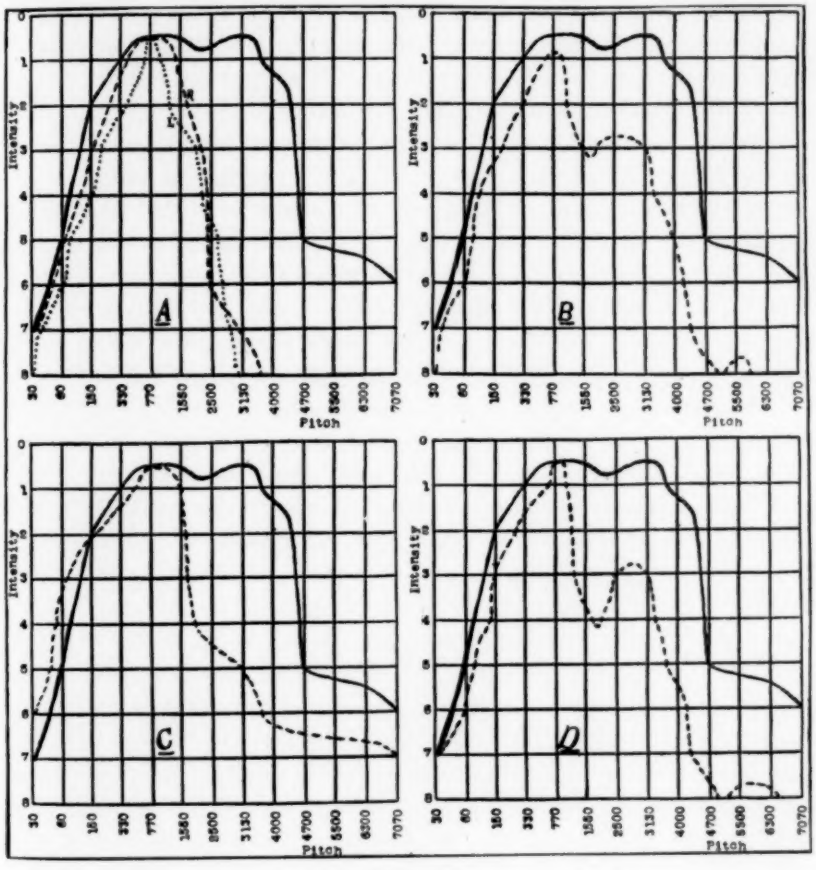

Figure 2

may occur. Curves similar to those shown in Figure 2 appear so often that it might be called a curve typical of inner ear deafness, for here we have the classical picture of labyrinthine involvement, namely, undiminished acuity for low tones and a very marked loss for those in the upper musical scale. The forks, with the exception of the c^4 and c^5, were normally heard in all four cases. Curve *A* was diagnosed neuritis nervus acousticus. Curve *B* was from a case of chronic suppurative

otitis media, the tympanic membrane being thickened and scarred, and showed a perforation in the anterior portion. Clinically, the picture was one of middle ear disease, but the curve for hearing was quite typical of inner ear deafness. The curve *C* is similar, the hearing for low tones being exceptionally acute. The clinical diagnosis was chronic hyperplastic otitis media. The record shown in *D* was taken a few hours after the patient developed an acute earache. The tympanic membrane was reddened and bulging and had a small perforation inferior to the umbo. The history and the appearance of the membrane made the diagnosis of acute suppurative otitis media positive. The hearing tests, however, showed the classical picture of inner ear deafness.

In each of these four cases we have rather uniform curves of inner ear deafness. In the presence of an active middle ear lesion, if the diagnostician had attempted to draw his conclusions on the basis of the hearing tests alone, he would have done much harm to the patient, especially so in the last three cases. In view of these findings, however, it appears that the classical picture of the results to be expected from functional tests in middle ear lesions needs some modifications. The ease with which complete or partial tonal gaps and islands may be located by the audiometer, makes it of special benefit to the diagnostician in this respect. Careful examinations, requiring an hour or more, have often failed to indicate a defect in the tonal range which could be located with the audiometer in fifteen or twenty minutes. Any marked isolated defect in any portion of the tonal range can scarcely be understood as having its primary origin in any other part than the labyrinth. The frequency of the appearance of these phenomena is illustrated by the fact that fifty-five marked isolated gaps were found in the first 150 subjects tested during the last year. They appear in almost every type of ear lesion. Their real pathologic significance may be problematic, but should one of these patients reach necropsy, and microscopic examinations be made after a defect has been located in the tonal range, we would undoubtedly have considerable light thrown on our knowledge as to the nature of the hearing process. On the basis of classical definition, however, their clinical significance is very evident.

Figure 3, *A*, is the record of a case of bilateral chronic suppurative otitis media. The left ear presents a tonal gap extending from 1,600 double vibrations to 2,600 double vibrations. No gaps appear in the curve for the right ear. In the tests with the octave forks, the results were identical, with the exception of the c^4 (2,048 double vibrations) which in the right was recorded as $\frac{1}{48}$[7] and the left $\frac{9}{48}$. While the

7. The fraction indicates that the fork, which is normally heard at 48 inches (121 cm.) was heard by this ear at 1 inch (2.5 cm.).

tuning forks indicate the presence of the defect, its extent is more vividly demonstrated by the curve. Certainly, the more active labyrinthine involvement was shown in the left.

Figure 3, *B*, is the record of a case of subacute pernicious anemia, in which the ear condition was diagnosed as neurolabyrinthitis. The presence of the tonal gap in the left ear was not indicated in the tuning

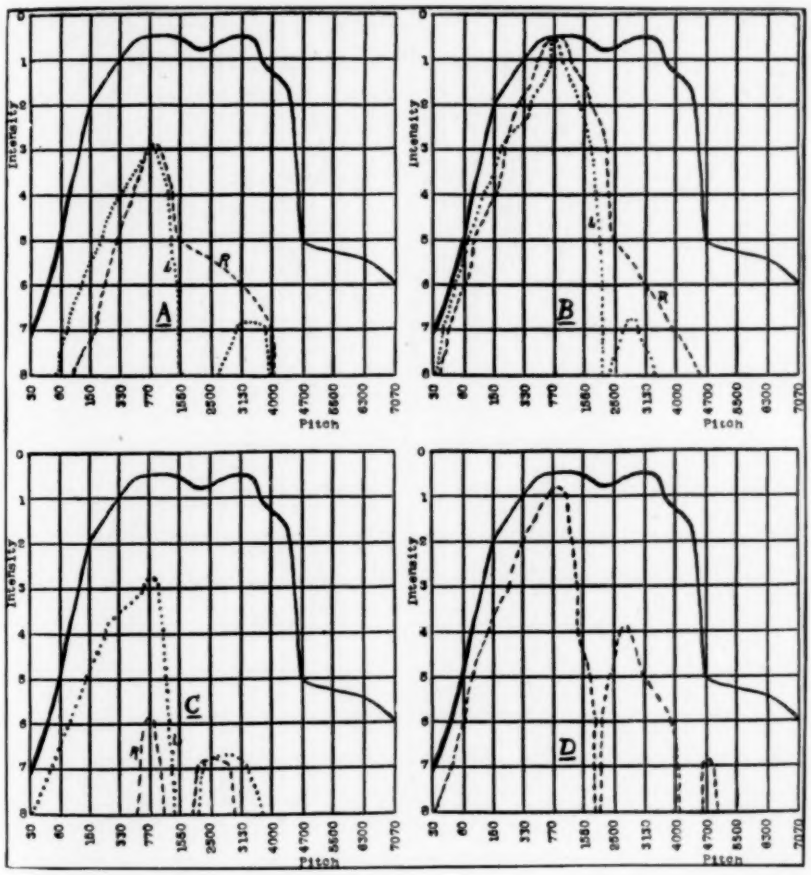

Figure 3

fork results. The sudden straight drop in the curve for the left ear at 1,800 double vibrations, taken in consideration with the general nature of the disease, would lead to the conclusion that we have here a lesion definitely localized in the cochlea, a condition which would certainly be less apparent from the appearance of the curve from the opposite ear.

The effects of syphilis on the inner ear have been definitely shown on the basis of microscopic examinations by pathologists, and the results

of their studies are well known. Nevertheless, it is true that these studies have added little to our knowledge of the labryinthine function. If we study the curves shown in *C*, Figure 3, a case of neurolabyrinthitis of syphilitic origin, in the light of the knowledge we have received from these pathologic studies, we see a distinct correlation. The cochlear destruction, which we know often takes place with syphilis, is here

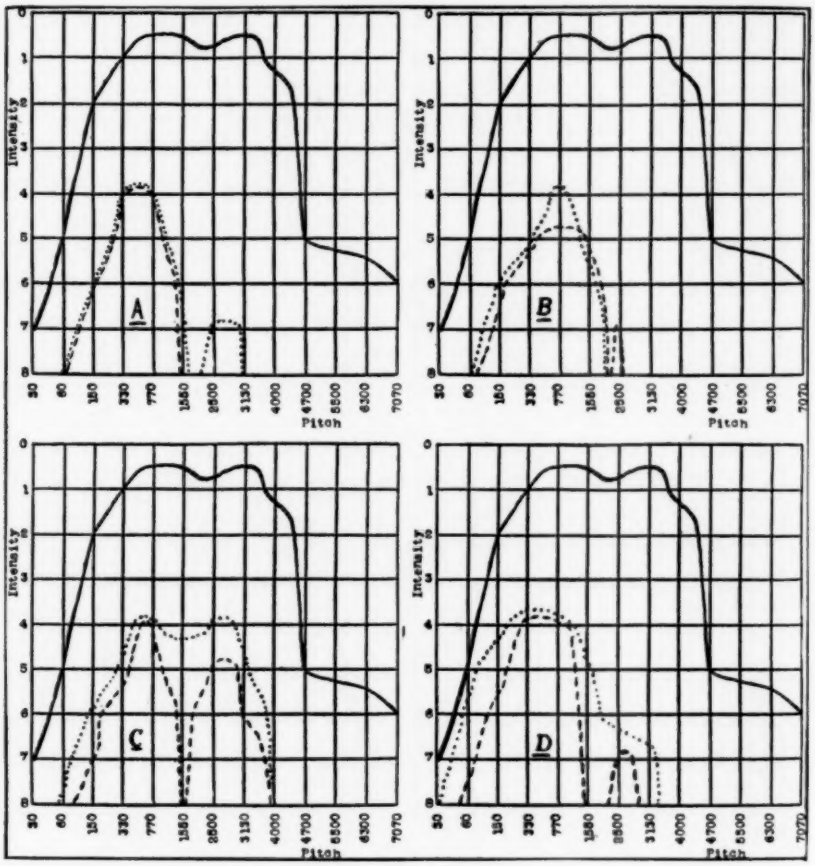

Figure 4

shown localized to a certain limited region. The fact that the gap occurs in each ear in a region close to 1,500 double vibrations, indicates the similarity of the lesion in both. The gaps were demonstrated only in the audiometer curve, as no tuning fork of this pitch was available. The c^4 and c^5 were diminished equally in both ears.

The very narrow gap shown in *D*, Figure 3, was verified by testing with the c^4 fork. The hearing for the c^5 was also markedly dimin-

ished. Since no fork was available for testing the intervening tones, the presence of the islands at 2,100 double vibrations and 4,600 double vibrations were not suspected until the audiometer test was made. The diagnosis of acute suppurative otitis media was perfectly apparent from the appearance of the membrane and from the history. The patient developed an acute earache, with discharge, forty-eight hours before the tests were made.

The cases represented by the curves of Figure 4 were selected because of their similarity of contour. They were all bilateral, the hearing was markedly decreased and all presented tonal gaps which were partially verified by the tuning fork tests. All were young adults. Each had a

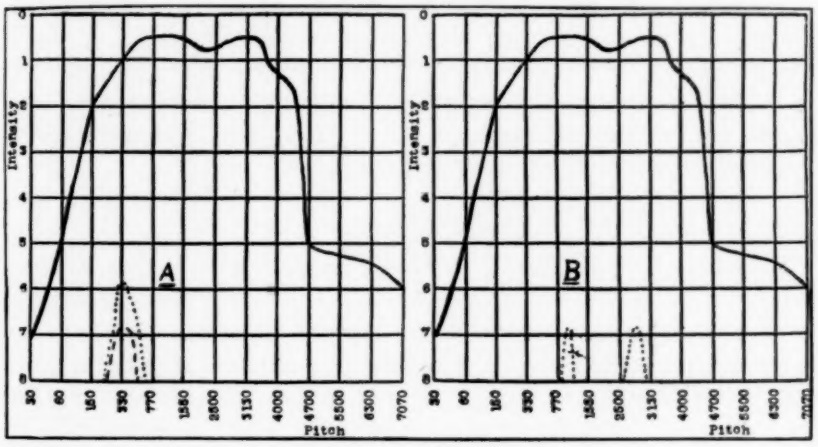

Figure 5

different diagnosis. *A* was a case of bilateral recurrent otorrhea. Both membranes were thickened and scarred, had small central perforations and a slight amount of pus in each canal. *B* represents the findings rather typical of chronic hyperplastic otitis media. Paracusis willisiana was present. The Gelle test showed that the stapes were not fixed. The membranes were markedly retracted. *C* had the appearance usually noted in cases of chronic suppurative otitis media. A profuse, foul-smelling discharge was present in each canal, and there was a large perforation in the posterior part of each membrane. The gap at 1,500 double vibrations could not be verified since no fork of this pitch was available. *D* is a case of acoustic neuritis accompanied by retinitis pigmentosa. The tuning fork results were identical in both ears, except the c^3 was recorded slightly poorer in the right. The island from 2,300 double vibrations to 2,700 double vibrations could not be verified without special forks.

It is expected that in cases similar to *D*, where there is undoubted neural involvement, the presence of tone gaps and islands might be common. In cases of marked middle ear involvement, it might be suspected that these phenomena would be rare. It is evident from the first three cases of this group that they frequently accompany middle ear lesions, and may easily be missed in the tuning fork examinations.

The curves in Figure 5 reveal islands frequently met in cases of extreme deafness. Since they have individual interests, they will be described somewhat in detail.

A was given by a man, aged 80, suffering with leukemia. A week before the tests were made, there was a sudden and almost complete loss of hearing. The patient could distinguish a noise when the examiner shouted into his ear but could not understand words. All questions of necessity were in writing. The diagnosis was exudate in the cochlea.

B was given by a woman, aged 52, an epileptic subject. The deafness had been preceded by intense tinnitus, was progressive for over twenty years, until at time of examination only loud yelling close to the ear could be heard. The diagnosis was otosclerosis.

CONCLUSION

Audiometer curves show in an accurate diagrammatic manner the relative hearing power over a wide range of tones. Tonal islands and gaps, and regions of slight or marked loss of sensitivity are apparent at a glance and easily interpreted in the light of classical definition. On this basis, the audiometer distinctly aids in the differentiation of middle and inner ear lesions. So far as otologic procedure is dependent on the measurement of hearing, the audiometer is a distinct aid in actual practice.

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LARYNGOSTOMY FOR LARYNGEAL STENOSIS *

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PHILADELPHIA

The operation of laryngostomy for chronic stenosis of the larynx is indicated when other methods of treatment, especially dilatation by intubation and bouginage, fail to effect a cure. As we are all well aware, the ultimate success of laryngostomy depends on the proper technic and procedure at the primary operation, but to an even greater extent on the after-treatment, which usually extends over a period of from three months to a year. Daily dressing and proper adjustment of dilating apparatus are necessary as, at any time prior to complete epithelization and dilatation, complications may occur which may render the operation worse than futile. The technic in these cases is that of Chevalier Jackson. The postoperative dilatation principle of Killian, using a soft rubber dilating apparatus, was used in two of the cases. Certain modifications and changes in apparatus, which appear to be an improvement, were made.

REPORT OF CASES

CASE 1.—*Atresia of the larynx treated by laryngostomy.* This patient was a boy, aged 9 years, who had complete atresia of the larynx when admitted to the clinic. The history revealed primary syphilis in one of his parents, nine years before the birth of the patient. The patient had had the usual diseases of childhood, without complications or sequelae. The laryngeal history began with weakness of voice and croupiness, following a mild attack of influenza three years previous to admission. Diphtheria followed one and a half years later, but there was no laryngeal involvement. Eight months before admission the child developed choking attacks with noisy breathing at night; he was hoarse intermittently, but never aphonic. The attacks became less frequent and severe until three months before admission, when an unusually severe attack occurred. Intubation was attempted without success and tracheotomy was done in emergency. Three months later the patient was referred to the Bronchoscopic Clinic. On admission, the boy was well developed and well nourished. Mirror examination of the larynx showed fixation and infolding of the left arytenoid. The right arytenoid was freely motile. The cords were not visible. No air could be forced through the larynx. The child had a slightly developed buccal voice, similar to that of a laryngectomized patient. The tracheotomy cannula was high, passing through the cricothyroid membrane. On removal of the tube no air passed through the larynx. General examination revealed no other indication of disease. Roentgen-ray studies showed that the chest was normal, and repeated blood Wassermann tests were negative.

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* Read by invitation before the Section of Otolaryngology of the College of Physicians, Philadelphia, Jan. 16, 1924.

Laryngostomy was done under ether insufflation. The cicatricial tissue was excised from the larynx and a gauze pack inserted. This was changed daily. Packing was replaced at the end of two weeks by a Jackson laryngostomy cannula, with rubber tube dilator over the upright cannula (Fig. 1). The progress of the patient was not as rapid as is usual. An unusual amount

Fig. 1.—Roentgenogram of laryngostomy apparatus of Jackson in position, in boy, aged 9 years (Case 1).

of granulations and degree of pharyngitis were present; the tonsils looked suspicious, and finally an attack of acute tonsillitis developed. After recovery the tonsils were removed. At the same time masses of granulation tissue that had formed in the region of the thyroid cartilage were removed. Following the removal of the infected tonsils, the progress was much more rapid.

The apparatus has been out of the larynx for about three months. The patient has very good motility on the right side of the larynx, and the left side is improving. Phonation is with the ventricular bands, but is loud, though deep in pitch. New cords are being pulled out by arytenoid traction. The prognosis is favorable for a good voice. The patient is breathing entirely through the larynx, the fistula in the neck being closed with adhesive plaster.

Several courses of protiodid of mercury have been given, and his general physical condition is good. Mentally the boy is bright. The points of interest in the case are:

First, an infective laryngotrachitis, with an undoubted factor of hereditary syphilis.

Second, attempted intubation with possible trauma to the left arytenoid.

Third, emergency tracheotomy was done high, and the wearing of the tube for a long time in this position contributed greatly to the stenosis.

Fourth, the influence of the diseased tonsils. The infective disease developing after the laryngostomy, the tonsillar condition undoubtedly became a factor in the unusual reaction in the larynx. This was clearly shown by the rapid progress after their removal.

Present conditions indicate that the functional result in the larynx will be excellent, and that the fistula in the neck can soon be closed.[1]

Case 2.—*Cicatricial laryngeal stenosis.* A woman, aged 40, married, whose general health was good previous to the development of goiter. No respiratory or vocal symptoms appeared until after the removal of this goiter by surgeons in another city. Immediately after the operation the patient developed a bilateral recurrent paralysis. The dyspnea was not relieved until tracheotomy was done eight months later. A two stage tracheotomy was planned by the surgeons then in attendance and the first stage was carried out. The neck was opened and packed with gauze down to the trachea. The following night dyspnea increased and the patient stopped breathing. In the emergency, the resident physician put the tube in through the cricoid. On admission to the bronchoscopic clinic, roentgen-ray studies of the neck and chest were made and found negative for thymus, substernal goiter or pulmonary pathology. Direct laryngoscopic and bronchoscopic examination revealed a narrowing in the subglottic space, but it was thought that ventriculocordectomy would give sufficient lumen for breathing. This was done at four sittings. The results were not satisfactory, due to the subglottic stenosis, and laryngostomy was performed. The larynx was opened, following the Jackson technic. The cicatricial tissue was removed and a gauze pack inserted in the larynx.

The rubber tube dilating apparatus was used at the end of two weeks, and at the end of two months very little progress had been made. Granulations were reforming rapidly and there was little evidence of epithelization. The tubing was ground smooth on the edges and boiled thoroughly before using and was shaped very carefully to fit the larynx. There was no evidence of perichondritis, but the larynx filled up in spite of all we could do. Dr. George Fetterolf saw the patient, in consultation, with reference to a possible tonsillar infection and advised against the removal of the tonsils. The larynx was opened a second time under general anesthesia and the obstructing lesions were again removed. We continued the use of rubber tubing, but the progress was slow. At the end of eight months the larynx was epithelized up to the level of the true cords, but every attempt to increase the size of the dilating apparatus above this level aroused such violent reaction in the arytenoids that it had to be abandoned. We then tried other apparatus that included metal intubation tubes, hard rubber plugs and intubation tubes and retrograde plugs (Fig. 2).

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1. Since this was written the child has been without any apparatus for six months and is now completely cured.

These were used until it occurred to me to try covering a smooth and properly shaped rubber tube with the finger of a surgeon's rubber glove, in such a manner as to make the upper end and contact surfaces perfectly smooth. This was tried and caused no reaction. Later we found a special reinforced finger cot (Fig. 3, No. 4) even more satisfactory than the glove finger. The

Fig. 2.—Roentgenogram of finger-cot covered rubber tube plug of the author's laryngostomy apparatus in use, with tracheotomy cannula in position in adult (Case 2). This plug is also adapted to the author's laryngostomy tube.

larynx below the level of the cords was now epithelized, and a tracheotomic cannula was substituted for the laryngostomy cannula (Fig. 4). The inflammatory condition of the arytenoid eminences and aryepiglottic folds subsided promptly, epithelization progressed, and, by the addition from time to time of extra thicknesses of glove finger or finger cot, we have brought the size

of the plug up to 45 French, which seems to be the limit of the cartilaginous framework of the patient's larynx. There has been such a marked improvement that we feel the apparatus can be removed very soon for a test period.[2]

The points of interest in this case are:

First, the initial cause: recurrent paralysis following thyroidectomy.

Second, emergency tracheotomy through the cricoid cartilage, which saved the patient's life though it increased the subsequent difficulties.

Third, most unusual intolerance to the dilating apparatus. We have never encountered a larynx so intolerant. In this connection it may be noted that the histologic examination of the tissue removed at the second operation showed it to be inflammatory and not neoplastic.

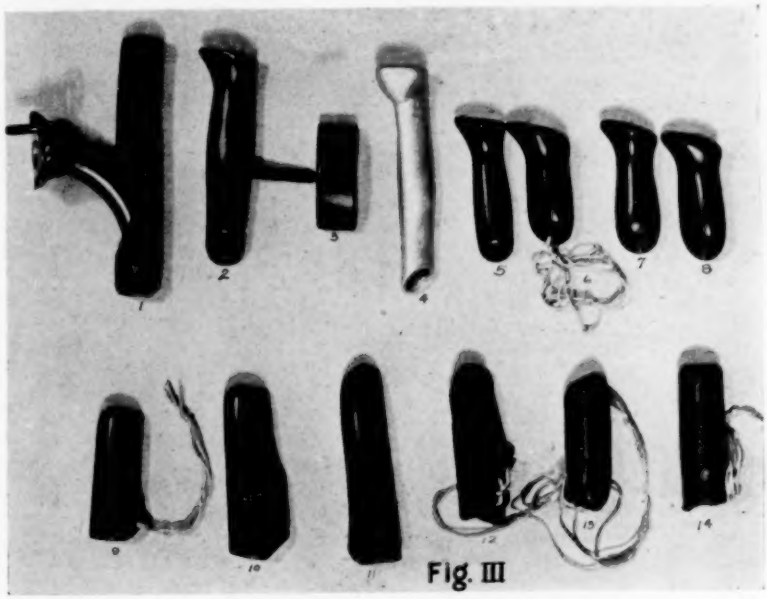

Fig. 3.—Laryngostomy apparatus. 1. Jackson laryngostomy tube fitted with rubber dilating tube. 2. Jackson self-retaining intubation tube showing retaining post and block (3). 4. Jackson intubation tube. 5. and 6. closed hard rubber plugs. 7. and 8. open hard rubber plugs pulled in from above by means of a string carried up through the larynx from the laryngostomy opening, and worn above a tracheotomic cannula. 9. Closed. 10. Open hard rubber plugs put into larynx from below and worn above tracheotomic cannula. 11. Surgeon's rubber glove finger used for covering rubber tubes for plugs. 12, 13 and 14. Complete plug with string for attachment to tracheotomy tube.

The favorable effects of the use of the glove finger cover in this intolerant larynx led me to use it in other patients, and the results have been very favorable. I have adapted the laryngostomy tube of Jackson to the use of this apparatus, and have also used a cigaret drain cover for covering the open tube and the gauze packs. I have noted that the use

2. The apparatus has now been out four months, with steady improvement during the test period.

of the finger cot and rubber cigaret drain cover, by making the surfaces of the apparatus smooth and nonirritating, lessens the tendency to the formation of granulation and promotes epithelization. They permit of an increase of size with the utmost nicety all over the surface of the plug, with an evenness obtainable in no other way.

Case 3.—*Cicatricial stenosis of the larynx.* A girl, aged 3 years, had been hoarse since birth. When she was 8 months of age she became dyspneic, and laryngeal examination showed evidence of papilloma of the larynx. Tracheotomy

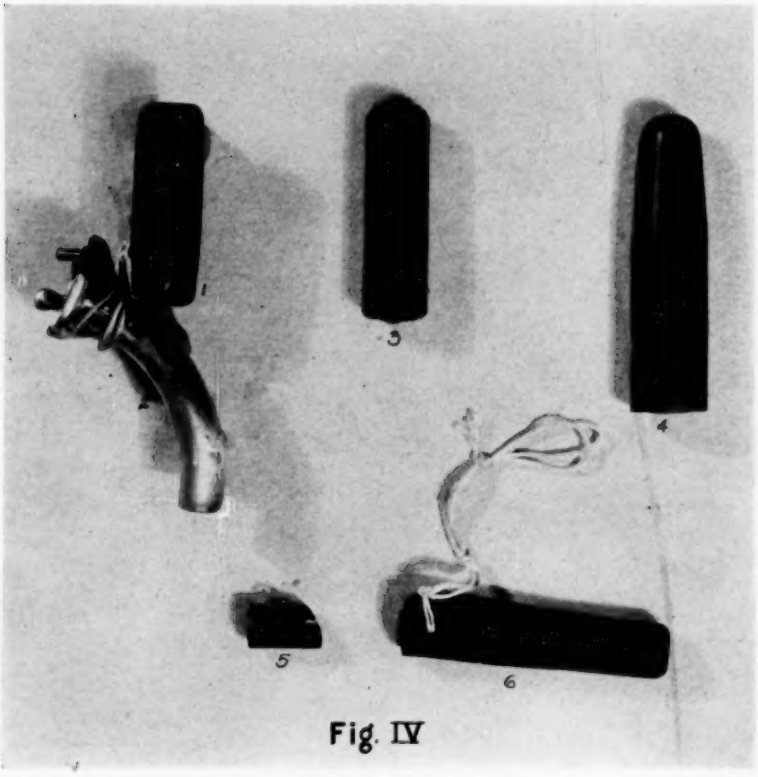

Fig. IV

Fig. 4.—Laryngostomy apparatus. 1. Finger-cot plug attached to (2) tracheotomy tube, as used in Case 2. 3. Glass molded rubber tubing core. 4. Reinforced finger-cot cover. 5. Metal collar of the author's laryngostomy tube used in making closed tube (6). The open end of the finger cot is inverted into the tube ahead of the collar and a string passed through the loop on the collar, making it secure. A slit in the closed end of the finger cot opens the tube and allows the patient to breathe through the mouth. This is for use with a tracheotomy cannula.

was done and the masses of papilloma were removed. Six months later radium was used in the larynx, and at the end of five months a second application was made. Following this, it was believed that adhesions formed in the larynx and the child developed complete atresia.

On admission to the Bronchoscopic Clinic eighteen months later, the child was fairly well developed and well nourished. The tracheotomy tube was in good position well below the cricoid. There was no evidence of radium burn of the neck. Roentgen-ray examination of the chest was negative. Direct laryngoscopic examination showed that the larynx was completely closed, with firm, swollen tissue. The resulting diagnosis was perichondritis plus papilloma.

The child was kept under observation for three months, frequent direct laryngoscopies were done and at no time was the larynx found patulous. Diseased tonsils were removed preliminary to laryngostomy. On opening the larynx, complete atresia was found at the cricoid level. The thyroid cartilage was split, and on careful exploration of the cricoid area it was found that the

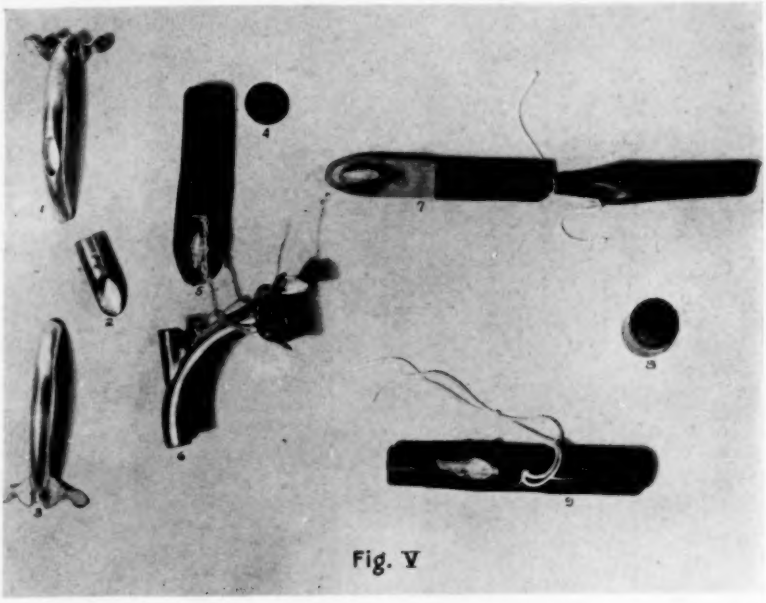

Fig. 5.—Author's laryngostomy apparatus. 1. Open inner cannula. 2. Collar for attaching rubber dilating unit. 3. Closed inner cannula. 4. Open end of (5) cigaret drain covered rubber dilating tube. 6. Laryngostomy cannula of the author. 7. Extra thicknesses of cigaret drain cover added to tubing to increase size, and string tied around cigaret drain cover before it is pulled over to close the upper end. 8. Closed end of finger cot tube (9). Closed cannula (3) is used for closed tube (9). Open cannula (1) is used for open tube (5).

anterior half of the cricoid cartilage was entirely destroyed. The only remnant of cricoid was an island of cartilage posteriorly, with a pouchlike formation extending upward to the level of the posterior commissure, which was lined with mucosa continuous with that of the trachea. This tissue was incised from below upward, and the scar tissue in the larynx cut through in a direction parallel with the long axis of the trachea. The trachea was opened down to the tracheotomic fistula and a pack was inserted. At the end of two weeks a pack, covered with the thinnest rubber cigaret drain cover, was used above the tracheotomy tube.

The child developed chickenpox, which was epidemic in the ward, and severe tracheobronchitis. This subsided at the end of two weeks. The wound

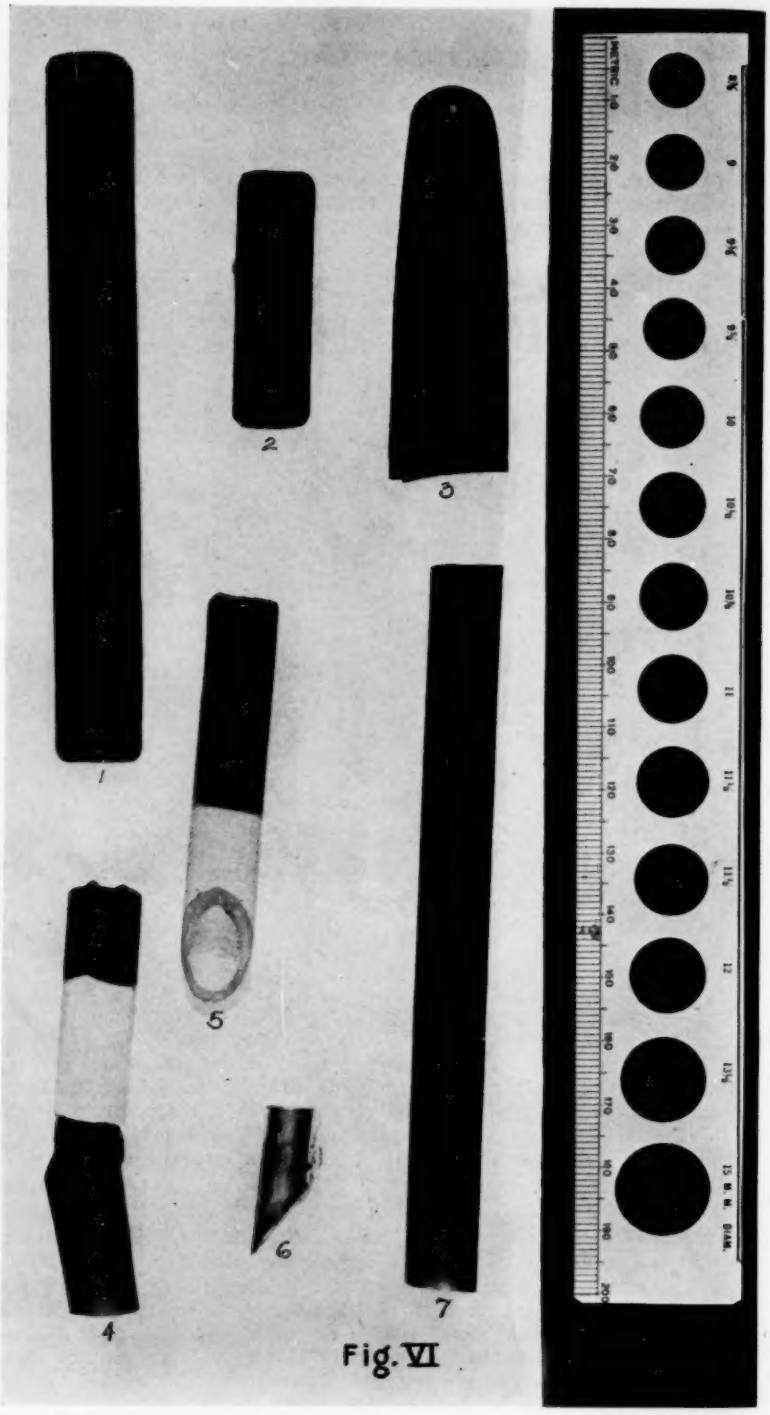

Fig. 6.—Laryngostomy apparatus. 1 and 2. Glass molded rubber tubing graduated on French scale. 3. Reinforced finger cot. 4. Cigaret drain cover on open tube. 5. Extra layer of cigaret drain cover to increase size. 6. Laryngostomy collar for holding tubing and finger cot. 7. Rubber cigaret drain cover, "Penrose" tubing.

opened very widely under the pressure of the pack. There was no leakage of food through the larynx on swallowing and it was decided to remove the pack entirely, as the larynx now showed healthy granulation.

Montgomery tapes were attached to the skin of the neck on either side, external to the border of the sternomastoid muscle. The tapes were tied over the gauze, pulling the edges of the muscle toward the median line and the skin edges together. A dressing was applied and a laryngostomy tube, with dilating apparatus of rubber cigaret cover, was put in through the old fistula, the lower border of which was epithelized.

This dressing has been continued for about a month. The wound is healthy and is epithelizing rapidly. The child coughs through the mouth readily when the skin edges are pulled together with the tapes.

The hope of keeping the larynx and trachea open without the support of the cricoid ring is a forlorn one. But if the favorable progress continues,

Fig. 7.—Tracheotomic insufflation cannula. For insufflation anesthesia through a tracheotomic opening for operations about the head and neck, such as laryngostomy, laryngofissure and laryngectomy. In laryngectomy it is used through the preliminary tracheotomic wound. In the operation without tracheotomy it is used in the larynx after the larynx is brought forward, and also in the trachea after the larynx is severed. It keeps the anesthetist and his apparatus entirely out of the operator's way, expediting the operation by doing away with the interruptions for reapplication of the anesthetizer's gauze.

The smaller size is for use in children; the larger size for adults. The long arm (B) enables the anesthetist to get well out of the field of operation above the head of the table.

the wound will soon be completely epithelized and a deep trough formed in the front of the neck, which will afford an excellent opportunity for the construction of a laryngeal airway by plastic surgery.

The points of interest in this case are:

First, the use of radium resulted in the destruction of the cricoid cartilage from perichondritis.

Second, absence of a cartilaginous framework presented the utmost difficulty in creating a lumen.

Third, the peculiar pouching upward back of the cricoid remnant was probably due to cough. The same force kept the trachea and larynx dilated without a pack when the skin was pulled together in front.

For anesthetizing these patients with laryngeal stenosis for laryngostomy, I have devised an apparatus for tracheotomic insufflation that has facilitated the work considerably, particularly in small children (Fig. 7).

The various forms of apparatus used in these cases are shown in Figures 3, 4, 5 and 6.

Most of them were especially devised or modified by me to meet difficulties encountered, for which older forms of apparatus failed to prove adequate.

CONCLUSIONS

1. Cases 1 and 2 illustrate the fact that has been strongly emphasized by Jackson, that high tracheotomy is the most frequent cause of laryngeal stenosis, and that, in patients who have worn the tracheotomic cannula through the larynx, laryngeal stenosis always results.

2. The danger of perichondritis and the resultant stenosis should always be borne in mind when radium is applied to the larynx.

3. Focal infection in tonsils, teeth and upper respiratory tract should be removed before laryngostomy, or as soon as its presence can be determined.

4. The use of the smooth, pure rubber cover (finger cot or cigaret drain cover), over the dilating unit lessens irritation and promotes rapid epithelization. By the addition of extra "covers," the dilating unit is increased uniformly and gradually in size, adjustment is greatly facilitated and dilatation is much more rapid than that accomplished by the most carefully fitted rubber tube dilator.

5. The use of the closed tube will control excessive cough due to aspiration of secretions, and its use is important in the early stages of the aftercare of laryngostomy patients.

LARYNGOSTASIS AND THE LARYNGOSTAT

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AND
LOUIS H. CLERF, M.D.
PHILADELPHIA

One of the greatest difficulties to be overcome in operative direct laryngoscopy is the tendency of the ventricular bands to close partially and sometimes completely the supraglottic larynx, so that the cords are not visible (Fig. 1). A second difficulty is the great difference in the appearance of the cords as compared with mirror laryngoscopy, in which, on inspiration especially, the ventricular bands remain well back to their respective sides, and the cords look thin and flat and often almost white.

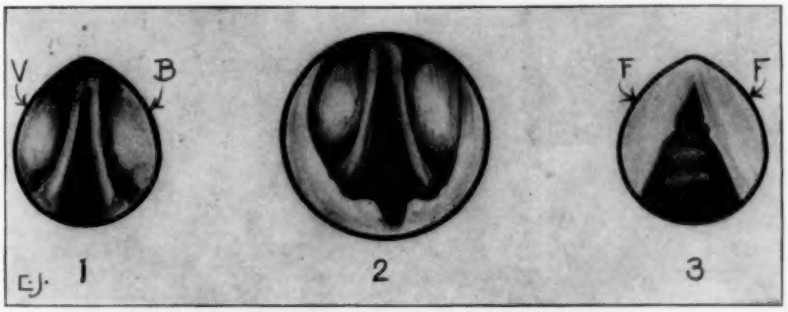

Fig. 1.—Pencil sketches, illustrating laryngostasis as contrasted with ordinary direct laryngoscopy. At *2* is shown schematically the broad, general view of the larynx afforded by the standard laryngoscope; the cords are rounded, the ventricular bands overhang the cords; moreover, in this procedure the cords move spasmodically and accurate work is impossible until the operator has learned the knack of laryngostasis. At 1 is shown schematically the view in the anterior commissure laryngoscope. The cords are rounded and the ventricular bands, *V, B,* overhang; there is, however, with this instrument a much less effort required to expose the anterior commissure and the knack of laryngostasis is easily acquired. At 3 is shown the exposure of the entire floor of the ventricle, *F, F,* obtainable with the laryngostat, with which the ventricular bands are pushed entirely to the side walls of the larynx out of sight. Moreover, the cords are held motionless in perfect laryngostasis, so that the utmost accuracy of forceps work is facilitated. A pair of vocal nodules are indicated in the sketch because of the necessity for the highest degree of precision in dealing surgically with these growths in singers. The laryngostat we find equally useful in the removal of papillomas and all benign growths, in which the utmost care to avoid injury to normal cordal tissue is imperative.

A third difficulty is the constant movement of the cords, which demands the utmost skill for accurate work. All of these difficulties are overcome

with practice. The direct laryngoscopist soon learns the knack of laryngostasis; that is, exposure and fixation of the larynx or the part of the larynx to be operated on.

For many years, we have been using a method of laryngostasis that consists in propping the larynx open with the tube mouth so that the ventricular bands are held apart, the floor of the ventricles are exposed and the edges of the cords are shown in sharp relief against the subglottic shadow (Fig. 1*B*). As this gives a good view down the trachea, it was originally called "supraglottic tracheoscopy" (Jackson [1]).

This procedure of laryngostasis can be performed with any tube that is small enough to go between the ventricular bands but a little too large to go readily through the glottis. It was originally done with a short

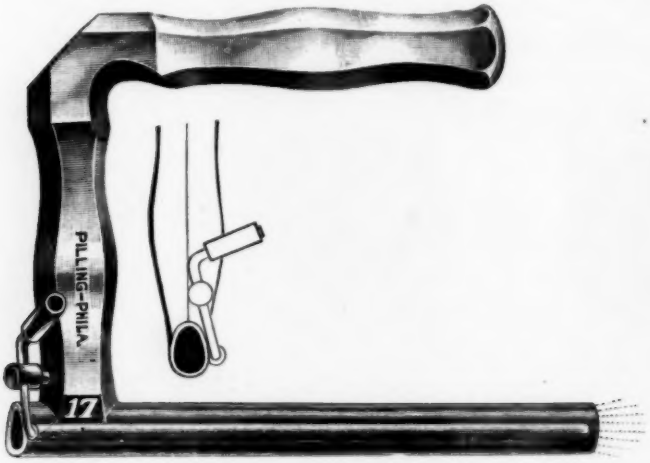

Fig. 2.—The laryngostat. With this instrument the knack of perfect laryngostasis is readily acquired. The larynx is propped open, the cords are absolutely fixed in the position of maximum abduction; the entire area of both ventricular floors is exposed.

round tube.[2] The handle was then improved to a form similar to that shown in Figure 2. As facility in direct laryngoscopy developed, it was found that the standard laryngoscope could be used for the purpose, and that the anterior commissure laryngoscope served very well indeed.

The best instrument, however, in the hands of most men undoubtedly is the one shown in Figure 2, and called by us the laryngostat. Its distal

1. Jackson, Chevalier: Tracheobronchoscopy, J. Laryngol., Rhinol. & Otol. **22**:616 (Dec.) 1907.

2. Jackson, Chevalier: Foreign Bodies in the Trachea, Bronchi and Esophagus. The Aid of Esophagoscopy, Bronchoscopy and Magnetism in Their Extraction, Laryngoscope **14**:265 (April) 1905 (Fig. 3); Peroral Endoscopy and Laryngeal Surgery, St. Louis, Laryngoscope Company, 1914.

end is so shaped that, when introduced into the larynx, it exposes both the vocal cords at once and gives a good view of the large part of both ventricular floors. Most important of all, it fixes the cords immovably (Fig. 1*F*) in the abducted position, giving the opportunity for the utmost precision in removing vocal nodules and small benign growths.

A STUDY WITH THE WEBSTER PHONOMETER OF THE SOUNDS EMITTED BY DIFFERENT PARTS OF THE TUNING FORK PRONGS*

ROBERT SONNENSCHEIN, M.D.

CHICAGO

I have long been interested in the functional testing of hearing, and for this purpose have employed the means and methods in common use. These include the Politzer acoumeter, the ordinary watch (the latter only on rare occasions, being regarded as unreliable, practically no two being alike in pitch or intensity), the unaccentuated whisper and conversation voice, the various tuning forks from the lowest to the highest pitches, the Edelmann Galton whistle, and the Struychen-Schaefer monochord. Latterly, several types of audiometers, preferably the one used by Drs. Dean and Bunch of Iowa City, and those perfected by the Western Electric Company, have been introduced, but we have not had sufficient experience with them to be able to express an opinion regarding them. Of these various measures, we have used mostly the unaccentuated whisper and conversation voice, but we know that it is difficult to have a criterion or standard since each person's voice is of a somewhat different pitch and quality, and it is difficult in testing to employ the voice in the same manner each time. Secondly, we have made use of the tuning forks from the C_2 (16 double vibrations) up to c^5 (4,096 double vibrations), not only for determining the range of hearing within these points, but for testing the hearing of tones within this range. We usually employed the A unweighted (108 double vibrations) fork of Bezold for the Weber and the Schwabach tests when the latter is performed by placing the fork on the vertex; and using the unweighted a^1 Bezold fork (435 double vibrations) for the Rinne test. For the highest tones, the Edelmann-Galton whistle and monochord are used. Since we are able with good tuning forks to get pure tones, either by placing weights on the lower pitched forks and thereby eliminating the overtones, or by having very well balanced unweighted forks in which the overtones last only for the first few seconds after the fork has been struck, we have relied mainly on tuning forks for the usual tests.

It will perhaps be best to mention briefly some of the terms used in describing the action of tuning forks and their physical characteristics.

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* From the Nelson Morris Memorial Institute for Medical Research of the Michael Reese Hospital.

* Read before the American Otological Society, at Swampscott, Mass., June 5, 1924.

The stem of a tuning fork is capable of exciting as great force as are the prongs. Energy is the capability of doing work. Intensity, as used in connection with sound, is the energy flow per second through a unit of area perpendicular to the direction of the sound waves. (Thus it is only a second wave which may be spoken of as possessing an intensity.) When the tuning fork is struck, the air waves emanate only from the broad or outer surface of the prongs, but after the waves have proceeded a short distance they spread out in all directions and therefore will appear to arise from the various portions or surfaces of the prongs. At the ends and at the narrow surfaces of the prongs, we have a slippage or sliding of the prongs through the air but no actual pressure or propulsion of sound waves. When struck, the prongs vibrate transversely with excursions of little force but great amplitude. The vibrations of the stem of the fork are simultaneous with, and last just as long as, those of the prongs, are longitudinal in character, of small amplitude, but of great force. The prongs move in opposite directions so that when a condensation and a rarefaction are propagated outward, these very nearly but not entirely overlap, resulting in the interference of the sound at certain points. Thus the intensity of the sound changes greatly with slight rotation of the fork about the vertical axis, giving the four points of interference noted by psychologists and others. It also changes in a modified manner at different distances from the stem. In addition to these factors, there is another one of great importance, namely, the slippage of air molecules around the prongs of the fork, which varies with the amplitude and with the velocity of motion of the fork prongs and causes a further modification of the sound intensity about the fork. Moreover, all of these factors vary with the pitch so that it is evident that air tests made in the usual manner are subject to much variation in precision. There can be no such variation as this in the intensity of the sound given off by the end of the stem of the fork, and for this reason tests of air conduction made with the stem in the manner we[1] have reported in another paper are not subject to these objections. It should also be remembered that there is a "center of percussion," at the junction of the middle and distal thirds of the fork prongs, which point when struck causes the fork to give the most intensity of sound and the least overtones. Thus it is best to excite the fork by striking the prongs at this point.

The frequency of the fork is proportional to the square root of the elasticity divided by the mass. The greater the elasticity (stiffness), the

1. Sonnenschein, R., and Minton, J. P.: Use of Tuning Fork Stem for Both Air and Bone Conduction in Rinne Test, Ann. Otol., Rhinol. & Laryngol. **32**:85 (March) 1923. Sonnenschein, R.: Methods and Interpretation of Fundamental Tests of Hearing, Ann. Otol., Rhinol. & Laryngol. **33**:423 (June) 1924.

higher the frequency. Therefore, the frequency varies directly as the square root of the elasticity. The greater the mass (weight), other things being equal, the lower the frequency. Therefore, the frequency varies inversely as the square root of the mass (weight). While we usually consider all intensity of sound as being inversely proportional to the square of the distance from a point source of sound in an open, unconfined space, this does not hold so accurately in a closed room in which most tests usually are conducted. This is because of the reflection of sound from the walls, ceilings and floors, together with that from furniture and other objects and the various standing wave systems which may be present in the air of the room.

Apparently there are not many references in the literature regarding the proper manner of holding forks, and the application of certain parts or surfaces of the prongs to the external auditory meatus. We have always felt that there should be uniformity in the presentation of the fork to the patient's ear. The method of holding the flat surface of one of the prongs parallel to and as close to the ear as possible without touching either the auricle or the vibrissae was taught in the Vienna Clinic, and is what I have always practiced. It seemed to us that the greatest intensity of sound is from the broad or outer surface of the prongs. Randall,[2] in 1920, called attention to the fact that probably the greatest sound intensity is observed when the ends of the prongs are held near the ear. We desired to determine for ourselves just which portion of the prongs of the fork (either the flat surface, the narrow surfaces held lengthwise, the very ends of the prongs or the angle between the flat and narrow surfaces of the prongs) emits the greatest intensity of sound. It has, of course, been known for a long time that at the angle between the narrow and the broad surface there is much less intensity of sound, due to the fact that we have an area of interference caused by the overlapping condensation and rarefaction phases of the sound waves from the two surfaces. We found no literature bearing directly on this subject of the testing of the intensity of sound of the various portions of the fork, and we therefore set about to perform the test in a number of ways.

In order to measure the intensity of sound, the phonometer devised by the late Prof. A. G. Webster [3] of Clark University was used. This consists of several parts, one of the principal ones being a small mirror attached to a metal disc suspended by several wires in the open end of a resonator. The closed end of the resonator is of glass, and at the opposite end of the apparatus is an eye piece having a scale, the division

2. Randall, B. A.: Trifles that Count for Efficiency, Ann. Otol., Rhinol. & Laryngol. **29**:796 (Dec.) 1920.

3. Webster, A. G.: Proc. Nat. Acad. Sc. **5**:173 (May) 1919.

points numbered in series of tens. By means of a small electric light, reflections are thrown from the mirror back on the eye piece so that a beam of light may be seen on the scale. This apparatus may be tuned through a range of from 200 to 400 double vibrations, and when adjusted to any one particular pitch, will respond only to that pitch. Depending on the intensity of the sound, variations will be shown in the width of the beam of light reflected on the scale in the eye piece. Webster claimed that the most recently improved model of the phonometer, which is the type we used, has almost the same sensitivity as the ear. Incredibly small changes in the reflecting surfaces of the room, or the movement of persons or of objects show changes in the light band. The extreme sensitivity of the apparatus is in some ways a disadvantage, since one must be so careful in presenting any sources of sound to the resonator end of the instrument, and in avoiding extraneous sounds which might have the same pitch as that to which the apparatus is attuned, otherwise great variation in the reading of the beam of light will be caused. The fact that the phonometer can be adjusted only to a range of from 200 to 400 double vibrations, limits one in the pitch of forks to be tested. We chose the $\dot{c}^1$ (256 double vibrations) fork made by the Standard Scientific Co. of New York, and after careful adjustment of the phonometer to this pitch, used this fork in all the tests which we will describe, except those carried out with a very accurate electrically driven fork of the same pitch made by Wm. Gaertner Co.

While it was thought desirable to have the fork as close to the phonometer as it would ordinarily be held to the ear, namely, a distance of about 2.5 to 5 cm., it was found that this was practically impossible with the electrically driven fork, owing to the width of the frame in which the fork rested. Four variations of the tests were used. These were: First, with the electrically driven fork at a distance of 10 cm. from the phonometer. Second, the fork actuated by means of a pendulum (25 cm. long) with a hard rubber weight at the end of it, the weight always dropping through an arc of 90 degrees thus giving the same impact each time. The readings were always made at the same time, namely, three seconds after the fork was struck, in order to get them at the same point in the decrement of the fork. Third, the fork was excited by means of the pendulum, first one surface or portion and then another presented to the ears of various persons at a distance of about 5 cm., and the relative intensities in the various positions observed by each person noted. Fourth: the fork was actuated by means of the pendulum and held before the open mouth of the properly attuned Schaefer resonator at distances of 6, 2 and 1 meters from the phonometer. It was at first thought necessary to use

the resonater at a considerable distance from the phonometer, in order to avoid too great an excursion of the band of light on the scale, but we found this was not the case.

In practical work with forks, the latter are held close to the patient's ear (about from 2 to 5 cm.). With the electrically driven fork, it was impossible to approach the phonometer as closely as this, but our idea was to see whether at different distances and with various methods of excitation, the different parts of the tuning fork prongs would give a varying degree of intensity of sound. Furthermore, as stated in the foregoing, the range to which the Webster phonometer responds being very limited, namely, from 200 to 400 double vibrations, we were unable to use forks of higher pitch, and it is therefore impossible for us to state whether the findings which we had apply only to forks of a pitch of 256 double vibrations or whether there might be a difference with the various forms and shapes of the prongs of the higher pitched forks.

I. ELECTRICALLY DRIVEN FORK

When using the electrically driven fork, it is noted that the forced vibrations of the table caused very marked excursion of the band of light. Placing the fork and its frame on a felt pad 2.5 cm. thick, gave sounds of much less intensity than when the apparatus was placed directly on the table. Still less loud were the sounds when the fork was placed on a rubber air cushion. Another difficulty experienced with the electrically driven fork was that the spark contact was not always the same size; therefore the intensity of the fork sounds fluctuated considerably. The fork we used was actuated by one large dry cell of about one and a half volts, and for a time by two of these cells. Owing to the difficulty of properly tilting the frame, it was not possible to present the edge of the tuning fork prongs as accurately to the phonometer as when the fork was held in the hand. It was furthermore observed that the tightness with which the screw held the stem of the tuning fork in the apparatus made a difference in the intensity of the tone. Likewise, the loudness of the tone varied with the contact of all or part of the frame of the apparatus with the table, felt pad or air cushion. In other words, when the frame was tilted, in order to present the edge of the fork to the phonometer with part of the frame not resting on the table, the sound was less intense than when the whole frame was resting thereon. It was seen that if the fork was held above or below the plane of the disc carrying the mirror of the phonometer, the light band did not show as much deflection as when the fork was on a level with the disc. It was also noted that the difference in pressure with which the tuning fork frame was resting against the table, felt pad or air cushion made a considerable difference in the excursion

of the light band on the scale. *A priori,* we would assume that with an electrically driven fork the intensity of sound would be quite uniform as compared with the sound of forks actuated by means of pendulum, pleximeter, etc. We feel, however, that there are so many factors influencing the apparatus, not the least one being the great variation of the sparks, that our results with the fork excited by pendulum and weight seemed more reliable and consistent. A valve controlled fork would probably give better findings.

With the electrically driven fork resting on a table at a distance of 10 cm. from the phonometer, the following averages were obtained: (The numerals given indicate the number of degrees on the scale of the eye piece of the phonometer.) Wtih the broad or outer surface of the prongs, an average of 17.3 degrees. The narrow surfaces held parallel before the phonometer, an average of 12.7 degrees. With the two ends of the forks presented before the phonometer, 11.1 degrees. The edge between the broad and narrow surface of the prongs, 7.1 degrees. With the electrically driven fork with the frame resting on the felt pad (2.5 cm. thick), at a distance of 10 cm., the following results were obtained: For the broad surface of the prongs, 14.5 degrees; fot the narrow, 8.4 degrees; for the end, 9.9 degrees, and for the edge, 4.5 degrees. With the electrically driven fork resting on a rubber air cushion, at a distance of 10 cm. from the phonometer, the following readings were obtained: For the broad or outer surface of one of the prongs, 13.3 points; the narrow surface of the prongs, 6 points; for the ends of the two prongs, 6.7 points, and for the edge of one prong, 3.3 points. It should be noted here that with the fork on the felt pad or air cushion, the sound obtained from the end of the fork was apparently more intense than from the narrow surfaces, which is contrary to the result found when the fork's frame was resting on the table. I cannot explain this difference.[4]

II. PENDULUM AND WEIGHT

Exciting the fork by allowing the weight attached to a string 25 cm. long to fall through an arc of 90 degrees, striking the "percussion point" on the broad surface of one of the prongs of the tuning fork, that is to say, at about the junction of the upper with the middle third of the prongs, then holding the fork 5 cm. from the phonometer and taking the reading three seconds after the impact of the weight against the fork in order to have the same point in the decrement of the fork each time, the following averages of deflection width of light band were obtained: The edge of the fork, 15.1 points; the end of the prongs,

4. Throughout this paper the word "broad" surface refers to the outer surface of the fork prong.

24.5 points; the narrow surfaces, 37.7 points; the broad surface of one of the prongs, 42.6 points. The same test was carried out in another series, but the fork after being excited was held only 2.5 cm. from the phonometer and the following averages were obtained: The edge of the fork, 9.2 points; the ends, 19.6 points; the narrow surfaces, 31.4 points and the broad surface of one of the prongs, 37.3 points. These averages are lower than those when the fork was held 5 cm. from the phonometer, but it is possible that in the previous series the fork each time was struck a little more accurately than in the second series; or it may be that the shorter distance from the phonometer does not give so good a phase relationship to the resonator as it did at the 5 cm. In any case, the ratio between the intensity from the various parts of the prongs is almost the same as in the other series. In these two series, the fork was held as close to the phonometer as is usually done when testing ears with forks.

In the previous tests mentioned with the pendulum and weight, the fork was always struck, then the reading made, and the vibration of the fork stopped before the pendulum and weight were again used to activate the fork. In order to see if we could get still further proof of the preponderance of the sound intensity from the broad surface of one of the prongs, and of the relation between the sounds given by the narrow surface, the edge and the ends, another series was carried out in which, after one impact with the weight against the broad surface of the prong of the fork, readings were made in two ways: First, presenting the edge to the phonometer and rotating the fork so that the end of the prongs, then the narrow surface and then the broad surface of one of the prongs were held before the phonometer in the order mentioned. Of course the fork's amplitude was decreasing from the time the fork was excited until the last reading was made and naturally, the greatest intensity of sound was present directly after the fork was struck. By the time the broad surface of the prongs was held before the phonometer, the fork's amplitude had diminished greatly. Even so, we got the following averages: For the edge, 21 points; the ends of the prongs, 23 points; the narrow surface, 34 points; and, lastly, the broad surface, 34.6 points. Although the broad surface was applied when the fork had been vibrating for at least ten to fifteen seconds, with it the intensity of sound was the greatest of all the four parts tested. Another series was conducted by simply striking the fork once and presenting the four parts successively to the phonometer in the following rotation: First the edge, then the ends, then the broad surface and then the narrow surface. This series gave the following averages: On the edge, 12.3 points; the end, 19.4 points; the broad surface, 33.8 points; the narrow surface, 22.9 points. The broad sur-

face showed the greatest intensity of all; the narrow surface being presented to the phonometer last, the sound was considerably less than with the broad surface, which we would have expected even if the narrow surface had been presented before the broad surface.

III. TESTING EARS

After exciting the fork by means of the pendulum and weight or by allowing a small pleximeter to fall from a perpendicular position to a horizontal one, striking the "percussion point" on the flat surface of one of the prongs, subjects were tested by holding the different parts of the prongs as accurately as possible 2.5 cm. from the ear, with the subject's eyes closed so that he was unable to know which surface or part was being presented. In one series of ten tests it was found on first applying the broad and then the narrow surface to the ear or vice versa, and having each person state whether the first or the second tone was the louder, that six times the broad surface was the louder, twice the narrow surfaces seemed to be the louder and twice the subject was unable to distinguish accurately between the two. As between the narrow surfaces and the ends, in seven out of the ten instances the narrow surfaces seemed to be the louder, once the patient could not distinguish between the two, and twice the end seemed louder than the narrow surfaces. Between the end and the edge, there was absolute unanimity ten times out of ten tests in that the end was heard much louder than the edge of the fork. In another series, between the broad and the narrow, five times the broad seemed to be the louder and five times the narrow surface. Between the narrow and the end, the narrow was the louder in eight instances, the end two times. The comparison of the end with the edge again gave unanimity in that the end was each time heard louder than the edge. In a third series, the broad surface seemed the louder seven times out of the ten tests as compared with the narrow surface. The narrow, as compared with the end, was heard louder in eight out of ten tests. The end as compared with the edge was heard louder in ten out of ten tests, so that apparently even with the ear the broad surface was heard louder than the narrow, although the difference here is not so great as it is between the narrow and the end. Still greatest of all is the difference between the end and the edge, which is always in favor of the end. One must remember that it is difficult each time to hold the fork at the same distance from the ear, and since we know that in general the intensity of sound varies inversely as the square of the distance from the source (modified by the condition of the room as noted in the beginning of the paper), the smallest differences in the distance at which the fork is held at one time as compared with another may make a very considerable difference in

the appreciation of the sound. However, we made the greatest effort to hold the fork at a uniform distance from the ear, and by repeating the tests a number of times, checked up on the result.

IV. TESTS WITH THE RESONATOR

For each surface or part of the prongs tested, the fork was excited by means of the pendulum and weight, letting the latter strike the percussion point of the flat surface of one of the prongs, the fork then held at the open end of a properly attuned Schaefer resonator. Tests were made at three different distances from the phonometer, namely, 6 meters, 2 meters and 1 meter. With the resonator 6 meters from the phonometer, we had one series of ten tests with the following averages: the edge, 6 points; the end, 5.8 points; the narrow, 11.3 points and the broad, 12.9 points. In another series of ten tests at the same distance, there was for the edge an average of 4.8 points; for the end, 3.7 points; for the narrow surfaces, 5.7 points, and for the broad surface, 6 points. We note here the differences between the broad and the narrow are insignificant, and that the difference between the edge and the end are also very slight. It is remarkable to note that the edge of the fork seems to give a louder sound than the end of the prongs. With the resonator two meters from the phonometer, the following averages were obtained: for the edge of the prongs, 15.6 points; for the ends, 10 points; for the narrow surface, 16 points, and for the broad surface, 20 points. Here we see again that the edge of the prongs seems to give a greater intensity than the ends of the prongs and almost as much sound as the narrow surface of the prongs. With the resonator one meter away from the phonometer, the following averages were obtained: for the edge, 4.1 points; for the ends, 4 points; for the narrow surfaces, 5 points, and for the broad surface, 5.1 points. Here we see practically no difference between the broad and the narrow and practically no difference between the end and the edge of the prongs; in fact, between all four planes there are no great differences.

We wish to call attention to the fact that while in all the other tests the general tendency is for the ends of the prongs to give forth a louder sound than the edge of the prongs, we have found with the resonator that the reverse is true. It is hard to explain this, except to say that when trying the effects of the ends of the fork before the resonator the presence of the hand holding the fork may have acted as a shield between the source of the sound, i. e., the open end of the resonator and the receiver of the sound, namely, the phonometer. It was also noted in the tests with the resonator that while the broad surface of the prongs of the fork gave the sound of greatest intensity, the difference between the reading obtained from the broad surface of the

prongs and the narrow surfaces, compared with the edge and the end of the prongs in all other tests, does not show the marked preponderance that we would be led to expect from the three series of previous tests, namely, that with the electrically driven fork; that with the pendulum activated fork held before the phonometer and that with the fork held before the ear. Since, however, the fork and the resonator were held at a much greater distance from the phonometer than was the fork in the other tests from the phonometer or the ear, it is possible that the reflection of sounds from the walls of the room entered into the effect to a considerable degree, and thus changed the result. Then again, the resonator simply amplifies all the sound and therefore the differences do not seem so great as when the forks are used without the resonator. This may be shown in a very simple example. When two persons are, let us say, 4 and 8 years old, respectively, the difference of four years is a difference of 100 per cent. When these two persons, however, have reached the ages of 40 and 44 years, the difference of four years in their ages represents a difference of only 10 per cent. In other words, even though the actual difference remains the same, the ratio varies greatly. Perhaps this is also true in the relation between the sound of the fork held a few centimeters from the phonometer and that when held 1, 2 or 6 meters away before the resonator which magnifies all sounds that are brought near it. With the fork so near the resonator, we perhaps have more or less a point source of sound. There is also the possibility that air currents about the ends of the prongs influence the sound when the fork is held close to the mouth of the resonator.

CONCLUSIONS

1. It is very desirable, not only to have uniformity in carrying out functional testing of hearing but it is also desirable to use a fork in the most advantageous manner.

2. The electrically driven fork, no matter how carefully manipulated, gives considerable irregularity in the result, owing to the fact that the spark varies, and for numerous other reasons. A valve controlled apparatus would probably give uniformity.

3. With the two types of forks used in this series of tests, it was found that the broad or outer surface of one of the prongs shows uniformly the greatest intensity of sound. This could, *a priori*, be expected from the fact that it is from this surface that the sound waves are emitted, this being the only surface that really exerts a pressure against the air.

4. The narrow surfaces of the prongs usually give an intensity next to that of the broad surface and greater than the ends of the prongs. In some of the tests, however, especially so with the elec-

trically driven fork resting either on a felt pad or an air cushion, the ends of the forks gave slightly more intensity than did the narrow surfaces.

5. The ends of the prongs always gave a much greater intensity of sound than did the edge of the prongs, except when the latter was held near the resonator, in which case the edge seemed a little louder than the end.

6. From a practical standpoint, I believe we may say that it is best to hold the broad or outer surface of one of the prongs of the fork parallel, and as close as possible, to the ear without touching either the auricle or the vibrissae, in order to get the greatest intensity of sound. However, if the same method is used in every case, it probably would not make much difference if either the narrow surfaces or the ends of the prongs are held at a uniform distance from the ear, but the edge of the prongs should not be presented to the ear. From the scientific standpoint, however, one should seek to develop the highest efficiency of any appliance, and the apparatus, whatever it be, should be so presented to the ear that the maximum sound is appreciated. For that reason, we believe that the broad or outer surface of the prongs should be the part held near the ear when the tests are made.

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DIABETES IN THE PRACTICE OF OTOLARYNGOLOGY *

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Until the last few years the patient with diabetes often failed to receive the assistance of the otolaryngologist, because of the fear of the results of operative interference. On the other hand, many optional procedures formerly undertaken resulted in diabetic coma, probably because of lack of control of the disease prior to and following operation. During the last few years there have been distinct advances in the management of diabetes, particularly through the introduction of insulin; and in the light of this newer knowledge it seems important to determine the present status of the diabetic patient who has a lesion of the ear, nose or throat. We have, therefore, studied the case records of 416 patients who were hospitalized for the treatment of diabetes, during the period from Aug. 1, 1923, to June 1, 1924. All of these patients had true diabetes. One hundred and forty-one had an acute or chronic lesion of the ear, nose or throat; sixty-two of them were operated on (Tables 1 and 2).

It is quite evident that all diabetic patients do not have the same type of the disease as regards severity and prognosis. They seem to fall into four general groups; we, therefore, adopted an arbitrary classification, and thus were better able to observe the particular types of the disease (Table 3). In Group 1, the patients have the acute progressive type of diabetes with sudden onset of symptoms; they have a tendency to lose weight and strength rapidly, and a tolerance for sugar. It is the severe form of the disease and occurs most often in young adults and children. In Group 2 the patients are obese adults who have had a gradual onset of symptoms. In Group 3 the patients have the vascular type of the disease, common in middle-aged and elderly persons with demonstrable atherosclerosis. The onset is gradual and does not, as a rule, greatly incapacitate the patient. In Group 4 the patients are adults and the form of the disease doubtful; the onset is gradual, the patients are not overweight, and do not have atherosclerosis.

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The diabetic patient who is to undergo an operation on the ear, nose or throat is first observed in the metabolic ward. His tolerance is estimated; his blood sugar is determined at frequent intervals, and appropriate measures are instituted to control acidosis, if present. He is finally established on the dietary plan described by Wilder,[1] and insulin given if necessary. During this period an attempt is made to estimate the part played by the lesion of the ear, nose or throat. If, for example,

TABLE 1.—*Lesions of the Ear, Nose or Throat in Seventy-Nine Patients with Diabetes Not Operated on*

Type of Diabetes	Ear		Nose	Throat
	Acute	Chronic		
Acute	2	0	1	33
Vascular	0	1	0	15
Obese	1	1	0	21
Doubtful	1	0	0	11

TABLE 2.—*Type of Operation in Sixty-Two Patients with Diabetes and Lesions of the Ear, Nose or Throat*

Type of Diabetes	Tonsillectomy	Paracentesis of Drum Membrane	Drainage of Sinus	Mastoidectomy
Acute	33	1	2	0
Vascular	6	0	1	0
Obese	16	0	0	0
Doubtful	4	0	0	0

TABLE 3.—*Type of Diabetes in Four Hundred Sixteen Patients With or Without Lesions of the Ear, Nose or Throat*

Type of Diabetes	Total Cases	Cases Without Lesions of the Ear, Nose or Throat	Cases With Lesions of the Ear, Nose or Throat	
			Operated	Nonoperated
Acute progressive	151	81	36	34
Vascular	101	79	7	15
Obese	93	58	16	19
Doubtful	71	57	3	11
Total	416	275	62	79

a patient has infected tonsils and tonsillectomy is decided on, the carbohydrates in his diet are raised to 100 gm. daily for three days before operation; thus, he is afforded adequate glycogen reserve. If necessary, insulin is used to aid in metabolizing this diet. On the morning of the operation no food is allowed, but from 10 to 20 units of insulin may, or may not be administered, depending on the type of case. Five hours after operation, soft and liquid foods are given. Soft foods rich in carbohydrates are permitted, and sufficient insulin is administered to ensure the burning of glucose, and to prevent, or at least to minimize,

1. Wilder, R. M.: Optimal Food Mixtures for Diabetic Patients, J. A. M. A. **78**:1878-1884 (June 17) 1922.

any tendency toward acidosis. Traces of sugar in the urine are disregarded at this time, but no effort is spared to keep the patient absolutely free from acidosis. Although it has not been necessary to administer sodium bicarbonate during the postoperative course of any patient in our series, we would not hesitate to employ it in the presence of severe acidosis. When the patient is again able to tolerate solid food, he is re-established on his regular dietary regimen and insulin dosage.

All of the adult patients undergoing operation on the nose or throat were anesthetized with cocain and epinephrin. It is a fixed rule at the Clinic to use local anesthesia only in all operations on the nose and throat in adults, except in cases of malignancy. Children are given ether because, when skillfully administered,[2] it has appeared to be the least harmful of the general anesthestics for diabetic patients. Adults are given $\frac{1}{8}$ grain of morphin and $\frac{1}{200}$ grain of scopolamin one-half hour before operation. We have not observed delay in healing in any case in which local anesthesia was used, and in general the healing of operative wounds of patients whose diabetes was well under control has been quite normal.

Literature on otologic subjects contains many references to what has appeared to be a characteristic disease of the ear associated with diabetes. The frequency of otitis media occurring with diabetes, and its intractability to treatment have been noted. In our series, acute suppurative otitis media was found in only four cases, and in each instance promptly responded to early paracentesis and other appropriate treatment. The mastoid was not affected. Two of the patients had a very severe type of diabetes, and, although neither was in coma, both had severe acidosis on admission to the hospital. There were but three patients with chronic suppurative otitis media, and in each case the onset of the discharge antedated the onset of the diabetes. We are inclined to believe that, when diabetes is suitably controlled, a complicating acute otitis media will respond as well to appropriate measures as it would in the absence of diabetes. If, however, a patient with diabetes has disease of the mastoid, it would seem rational to operate without delay in order to prevent, so far as possible, the deleterious effect of the infection on the diabetes.

With reference to the nose, the operative procedures directed against an infected sinus are of prime importance because of the advantage of removing active infection in cases of diabetes. Submucous resection or any other operation which does not remove an infection should be viewed as a purely optional procedure, and should not be performed without careful consideration.

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2. Berkman, D. M.: A Preoperative and Postoperative Study of Diabetic Patients with Surgical Complications, Minnesota Med. **4**:28-37 (Jan.) 1921.

The mortality statistics in this series of cases are too limited to permit general deductions. None of the patients died as a result of operation, with one possible exception, in which lighting up of a chronic vegetative endocarditis produced a fatal septicemia. The other deaths occurred too long after operation to be ascribable to it. The deaths occurring in the group of patients not operated on were not attributable to lesions of the ear, nose or throat (Table 4).

We believe that one of the most important questions to consider is whether or not a patient's diabetes is favorably influenced by operations on the ear, nose or throat. This question must be considered from two standpoints: first, with reference to the immediate postoperative manifestations of local and systemic conditions, and second, with reference to the ultimate benefit accruing from the removal of a definite focus of infection.

TABLE 4.—*Deaths in One Hundred Forty-One Patients with Diabetes and Lesions of the Ear, Nose or Throat*

Case	Age, Years	Type of Diabetes	Operation	Date of Operation	Date of Death	Cause of Death
Patients Operated on (62)						
1	22	Acute	Tonsillectomy	4/26/23	12/ 1/23	Killed in accident
2	54	Obese	Tonsillectomy	6/24/24	6/29/24	Acute septic endocarditis
3	21	Acute	Tonsillectomy	10/ 7/22	11/21/23	Died at home, cause unknown
4	34	Acute	Tonsillectomy	3/ 7/23	3/21/24	Pneumonia
5	30	Acute	Tonsillectomy	4/ 4/23	11/ 7/23	Pulmonary tuberculosis
Patients Not Operated on (79)						
6	59	Doubtful	.....	.....	.....	Pneumonia
7	57	Obese	.....	.....	.....	Died at home, cause unknown
8	3	Acute	.....	.....	.....	Died at home, cause unknown
9	32	Acute	.....	.....	.....	Pulmonary tuberculosis

Our experience has taught that the presence of diabetes, when suitably controlled, does not retard the healing of operative wounds.[3] On the other hand, prolonged observation of patients, who have undergone an operation to correct a septic process, leads us to believe that the underlying diabetes is not improved. The most that can be expected seems to be a retardation of the rate of progression of the disease in the acute cases. If a patient is having attacks of tonsillitis frequently, and if each attack decreases the glucose tolerance, the removal of the tonsils seems to stop this decrease. It is difficult to determine whether chronically infected tonsils chronically affect diabetes unfavorably. In general, although we have seen little, if any, improvement in a patient's tolerance for sugar following the removal of such tonsils, we have occasionally recommended their removal, simply as a prophylactic measure, since many of them become acutely inflamed and definitely detrimental later.

3. Adams, S. F., and Wilder, R. M.: The Surgical Risk of the Diabetic Patient, S. Clin. N. Am. **4**:587-593 (April) 1924; Wilder, R. M., and Adams, S. F.: The Present Status of the Diabetic Patient as a Surgical Risk, Wisconsin M. J. **22**:557-561 (May) 1924.

In order to draw definite conclusions concerning the effect of lesions of the ear, nose or throat on the course of diabetes, two groups of patients with diabetes uncomplicated by other types of lesions should be studied, and the tolerance of these patients should be the subject of very close observation for a considerable period. One group should be studied before and after operation. The other group should be composed of patients with the same type of the disease, who had not been operated on.

It is, however, difficult to collect two such groups. Infections other than those of the ear, nose or throat are constantly appearing, operations are performed, patients become indiscreet in their diet, insulin dosage is changed, and there is a constant interplay of factors which make it difficult to determine actual changes in a patient's tolerance for a long period. All that can be said at present is that infectious processes, wherever their site, usually have a detrimental effect on a metabolic defect, such as diabetes. Although it is difficult to demonstrate many instances in which repeated infections of the ear, nose or throat have been solely responsible for repeated loss of glucose tolerance, we will continue to recommend the eradication of a focus which frequently becomes inflamed.

SUMMARY

Careful attention should be given to the preoperative and postoperative care of diabetic patients. Although a slight glycosuria during the postoperative period may be disregarded, no effort should be spared to combat acetonuria.

Local anesthesia is preferred for adult diabetic patients, and ether for young patients, undergoing operations on the nose and throat. Delay in healing has not been observed following the use of local anesthesia. None of the patients in the series died in diabetic coma following operation on the ear, nose or throat. Acute otitis media complicating upper respiratory infection was rare in diabetic patients, and when it did occur it was not more prone to involve the mastoid. No characteristic picture of disease of the middle ear complicating diabetes was found.

Drainage of a sinus of the nose is of prime importance, but an operation to correct a deformity should not be performed without careful consideration. Suitably controlled diabetes did not retard healing after otolaryngologic operations. An increase in the patient's tolerance for sugar after the removal of a focus of infection in the ear, nose or throat was not noted. Nevertheless, the sudden loss of tolerance, which so often accompanies and follows an acute infection, leads us to believe that the eradication of such a focus saves the patient from further loss of tolerance from this source.

THE DIAGNOSTIC PROBLEM IN STATUS LYMPHATICUS *

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In the light of recent investigation, there is an increasing and very justifiable reluctance to regard the so-called status lymphaticus as a pathologic entity, but this should not preclude its title adoption in a fresh discussion of the diagnostic problem involved in such an important physiologic and pathologic alteration complex. Its correlation with the researches of our own fellows, Loeb and Mayer,[1] on operative fatality incidence is most intimate and the purpose of this paper is to discuss this pathology, the problem involved in its preventive diagnosis, review the necropsy record and present for discussion a case report.

Here is a state of systemic alteration, variously synonymed, according to Ohlmacher [2] as: "Lymphatic constitution, lymphatic dyscrasia, lymphaticus habitus, lymphatic diathesis, lymphaticus chlorotic constitution, lymphatism status thymicus, status thymus lymphaticus;" the thymic asthma of Kopp,[3] the status lymphaticus of Paltauf,[4] the status thymicolymphaticus of Kohlbry,[5] historically confused with leukemia, pseudoleukemia, scrofula, chlorosis and exophthalmic goiter, which presents hyperplasia of thymus and general lymph adenoid tissue, including Waldeyer ring, hypoplasia of the heart and great vessels and a rather indefinite relationship to rachitis; a state furthermore which seems to present susceptibility to sudden death and this under a variety of conditions, particularly of the upper respiratory tract, hence its important link in the laryngologic field.

In directing the line of attack on this subject one is confronted by a field of amazing intricacy, the complex coordination of endocrine function, acquired endotoxin resistance and anaphylactic reaction.

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* Read at the Forty-Sixth Annual Congress of the American Laryngological Association, Swampscott, Mass., June, 1924.

* From the Department of Otolaryngology, University of Pennsylvania.

1. Loeb, Hanan W.: Fatalities Following Operations Upon the Nose and Throat Not Dependent Upon Anesthesia, and Subsequent Report, Ann. Otol., Rhinol. & Laryngol. **32**:1103 (Dec.) 1923. Mayer, Emil: The Toxic Effects Following the Use of Local Anesthetics, J. A. M. A. **82**:876-885 (March 15) 1924.

2. Ohlmacher: Status Lymphaticus, in Reference Handbook of Medical Sciences, **7**:928-937, 1917.

3. Kopp, cited by Lange: Am. J. Roentgenol. 74 (Dec.) 1913.

4. Paltauf, A., quoted by Ohlmacher: Ueber die Beziehung der Thymus zum plötzlichen Tod, Reference Handbook of Medical Sciences, 1917.

5. Kohlbry: Status Thymicolymphaticus in Infancy, Minnesota Med. **6**:89 (Feb.) 1923.

On each individual factor much research has been reported; on the combined syndrome, the record is far from complete. To express it tersely, the so-called status lymphaticus would seem to include the whole underlying fabric of lymphoid hyperplasia, the superficial field of which in the Waldeyer ring concentrates by all odds the major numerical percentage of laryngologic operation. Much opportunity, improved technic with its varied instruments and education in control of hemorrhage has indeed contributed a modicum of safety.

In face of this we are confronted with numbers of sudden fatalities in this simply rated procedure, seemingly unjustifiable in comparison to its magnitude. As cited in the foregoing, an heroic and valuable effort has been made to collect the statistics and their acknowledged etiology, but every laryngologist realizes how incomplete such a result must be; common report attests the great percentage beyond hospital regimen and control, the patient generally being unreported, and necropsies seldom done.

It is safe to assume, however, that popular trend would not far influence the consistent laryngologist of merit, whose guide would be conviction as to certain phases of relief, upper respiratory block, focal infection, lowered vital resistance or dentition necessity. To him it is of paramount importance to safeguard reliably the surgical procedure.

There seems to be a growing demand for a more searching analysis on such questions as these: (1) What is the real etiology and possible function of this thymic and adenoid tissue? (2) Are pathologic changes the cause or effect of hyperplastic change? (3) Does mass extirpation tend to increase or diminish marginal lymphoid areas? (4) Assuming the hemolytic streptococcic influence in ordinary acute involvement, running a self-limited period and establishing its own immunity, is it possible that such a walled off state may, within limits, still further function in blockade? One must seriously reflect on the researches presented by Wood [6] on tonsillar pathology, Pemberton [7] on the complex syndrome of focal infection, Fetterolf and Fox [8] on postoperative infections, Bloomfield and Felty [9] on the bacteriology of tonsillitis.

For the purpose of discussion, the premise might be asserted that: status lymphaticus, whether pathologically or physiologically rated, pre-

6. Wood, G. B.: Tonsillar Pathology in Relation to Infection, Tr. Am. Laryngol. A., 1923.

7. Pemberton, Ralph: On the Nature of the Influence of Focal Infection, College Physicians, Philadelphia, 1923.

8. Fetterolf, G., and Fox, Herbert: The Reaction of the Paratonsillar Tissues to Tonsillectomy, Am. J. M. Sc. **166**:802 (Dec.) 1923.

9. Bloomfield, A. L., and Felty, A. R.: Observations on Strains of Hemolytic Streptococci Recovered from Cancers, and Cases During an Outbreak of Acute Tonsillitis, Bull. Johns. Hopkins Hosp. **34**:379 (Nov.) 1923; Bacteriologic Observations on Acute Tonsillitis with Reference to Epidemiology and Susceptibility, Arch. Int. Med. **32**:483 (Oct.) 1923.

sents a definite menace to operative procedure and therefore: (1) Its suspicion should be recognized; (2) its diagnosis should be established; (3) operative decision should be measured with the same or more care than cardiac lesion, renal insufficiency or hemorrhagic liability, and (4) in case of sudden death, its justification should find a convincing picture conforming to status lymphaticus.

The symptomatic picture of the lymphatic state, concurrent with family history, would seem of prime value in establishing caution, history of sudden deaths in the family relation even inclusive of accidents in drowning, fatalities in surgical narcosis and under trivial surgical procedures, history of epilepsy or epileptiform attacks, infantile eclampsia, idiopathic tetany or any form of glottic spasm in patients or immediate family. Evidence of anaphylactic reaction to injections, antitoxins, serums or vaccines, lowered resistance to disease, rachitic evidence and even the constant tendency to bronchial cough is added by Ohlmacher.[2] Any of these conditions in cases of infective picture should warrant a careful thymic study. Pfahler [10] working with McKee, even states that the thymus can be enlarged without symptomatology at all, and it is interesting to note that Benjamin and Lange,[11] also quoted by them, on examination of 225 patients admitted to the children's department of Cincinnati Hospital, reported nineteen, or 8.47 per cent. with definitely enlarged thymus.

In the external picture, status lymphaticus patients present a pallid or pasty appearance of the skin, an overdevelopment of fatty tissue without ruddy physique, manifestation of latent rachitis, hypoplasia of genital system and scantiness of axillary and suprapubic hair and frequent suggestion of thyroid enlargement. Ewing adds in the female, delicacy of skin, narrow waist, arched thighs, delayed menstruation and ill-developed mammae. Paltau in 1889 suggests the suspicion of coincidence in the geographic goiter and status lymphaticus zones. To this should be added complete hyperplasia of the Waldeyer ring, including lateral tonsil masses. Culbert,[12] quoting Pibram of Prague, and Garraghan [13] add the abnormal enlargement of the follicles at the base of the tongue as symptomatic, and Lange, with others emphasizes the suffocation symptoms, dyspnea, respiratory stridor, retraction of intercostal and clavicular areas.

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10. Pfahler, G. E.: The Diagnosis of Enlarged Thymus by the X-Ray and Treatment by X-Ray or Radium, Arch. Pediat. **41**:39 (Jan.) 1924.

11. Benjamin and Lange: Report of Nineteen Cases of Hyperplasia of the Thymus Gland, Weekly Bulletin, Cincinnati Acad. Med., Feb., 1917.

12. Culbert, W. L.: Status Lymphaticus A Report of Two Cases, New York M. J. **104**:739 (Oct. 14) 1916.

13. Garraghan, E. F.: Status Lymphaticus with Report of Case, Illinois M. J. **34**:189-193 (Oct.) 1918.

ESTABLISHMENT OF DIAGNOSIS

It is not customary to study minutely such preoperative symptomatology, but sudden unaccountable death is a most unhappy reminiscence, and a thymic roentgen-ray examination would not add a much more serious routine in suspicious cases than the estimate of coagulation time. In establishing such diagnosis, percussion area of thymic dulness is not too successful unless thymic pressure is sufficiently great to cause a bulging mass in the jugulum or pressure symptoms in the mediastinal portal. As cited by Lindsay,[14] eczematous eruptions are of importance and perhaps associated with general exudative catarrhal state, even to increased endocranial fluid. Cameron [15] calls this status catarrhalis, which is the clinical analogue of postmortem status lymphaticus, a state of succession of catarrhs, upper respiratory, bronchial and intestinal, with skin excoriated from nasal discharge, generally erythematous and fissured, surface nutrition poor and frequent pyrexias all indicative of atrophic sequellae. Cameron further assumes the intimate relation of this catarrhal hygiene to later rheumatism, on the basis that such occurs when catarrhal nonpyogenic organisms pass through the lymphoid barrier into the blood stream. The suggestion, however, that this exudative diathesia is the struma or scrofula state is entirely tenable.

The operative decision is a corollary to the diagnosis and has an appropriate place in this paper. A study of necropsy statistics, both in general routine and in research for hyperplastic evidence impresses this fact, first that hyperplasia of the lymphoid system in moderate degree is a fairly constant occurrence, and second that vast numbers of such patients have been operated on successfully, and, with enlarged thymic evidence, fatality in a considerable percentage has not been due to status lymphaticus. It is of paramount incidence to the diagnosis problem that such patients should not be anesthetized with chloroform. If cardiac, arthritic, nephritic or even upper respiratory demand is so great as to warrant operative procedures, minimum anesthetic strain of any sort should be incurred.

POSTMORTEM DIAGNOSIS

It is of infinite importance to the operator who has been so unfortunate as to have a sudden unaccountable death under surgical operation, to establish a definite diagnosis of status lymphaticus, if such exists, and one whose apparent symptomatology should not reasonably have been anticipated. This is important psychically to the operator and to those immediately concerned; much unjustifiable condemnation would

14. Lindsay, L. M.: Infantile Eczema and Status Lymphaticus, Canad. M. A. J. **7**:135 (Feb.) 1917.

15. Cameron, H. C.: Status Lymphaticus from the Chemical Standpoint, Proc. Royal Soc. Med. 1916-1917.

thus be eliminated. These pathologic conditions would seem adequate in whole or reasonable part—hyperplasia of all lymph nodes, mediastinal, mesenteric, retropharyngeal, Waldeyer ring, superficial and deep collars of glands in the cervical region, Peyers patches and solitary follicles, this with definite enlargement, persistence and perhaps fatty changes in the thymus gland. Edematous and watery subcutaneous condition with hyperedematous condition of the brain, epiphyseal and other evidence of rachitis, undeveloped sexual accompaniment, hyperemic picture of viscera, vascular changes in spleen, with malphigian tufts closely packed with small lymphoidal cells, and in review of a case given below, we prefer to consider commensurate changes in the thyroid gland as of frequent occurrence, simple, cystic or parenchymatous.

Help under such dire circumstances would be definite evidence of tracheal and recurrent pressure; Jackson [16] has come to the rescue in this area and also by reference to backward pressure of the neck, with influence on the medulla. There is little agreement, however, as to relative percentage in this element of pressure.

The microscopic side of the lymphoid state as reviewed by Duke,[17] who quotes Bartel freely, indicates a conception of syndrome balance in the hyper- and hypo- factors, where the parenchymatous tissue is gradually displaced by fibrous stroma, producing the lymphoid starvation alluded to by other writers. This seems to be balancing of the various hormones present by the pathologic process and in general correlation producing hypoplasia or various skeletal, circulatory and genital subdivisions, including portions of the endocrine system, while the hypertrophic picture of general hyperplasia is going on elsewhere. It is probably pertinent in this connection to indicate the likelihood of composite information of value in some future accumulated evidence as to the importance of increased lymphocyte counts as either an infective disturbance or lack of balance in resistance, particularly as suggested by Daland,[18] in the presence of general leukopenia. Duke, in discussing the stigmas, points to the internal secretion as the causative factor. In the hypolastic constitution there is assumed to be a congenital or acquired weakness of parenchymatous elements, tending to early atrophy and replacement by connective tissue elements, these tissues not bearing the strain of life well. In this report Bartel, Neusser

16. Jackson, Chevalier: Thymic Tracheostenosis, Tracheoscopy, Thymectomy, Cure, J. A. M. A. **48**:1753 (May 25) 1907.

17. Duke, W. W.: Status Lymphaticus and Status Hypoplasticus and Their Relationship to the Glands of Internal Secretion, Jour. Missouri Med. Hist. **11**:207-212, 1914-1915.

18. Daland, Judson: The Diagnosis of Focal Infection, Ann. Clin. Med. **2**:187 (Nov.) 1923.

and others are represented as not accepting status lymphaticus as per se disease but part of generalized hypoplastic constitution.

The question of backward pressure of the head and pressure of the enlargement in the superior mediastinum has been demonstrated by Jackson, Rehn,[19] Hedinger,[20] Brucke and others.

In one of my cases, clearly a lymphatic patient, a child, aged 5 months, died instantly under pressure of instrument and backward bend of the head, while the hospital resident was opening a retropharyngeal abscess. Necropsy was refused. Hedinger has reported eighteen cases of thymus death demonstrating pressure; a case reported by Stone evidences similar pressure symptoms, and here, as in my case, rapid tracheotomy was totally ineffectual.

In statistical review the most conclusive reports have come from 4,000 necropsies at Bellevue Hospital, as reported by Symmers,[21] in which status lymphaticus was already demonstrated in 249 subjects or 61.2 per cent., males 197, females 52. Of these patients 51.7 per cent. registered enlargement of faucial tonsils, lingual tonsil 49 per cent., pharyngeal follicles 38 per cent., Peyer's patches and solitary follicles 89 per cent. Enlarged malpighian splenic follicles 85 per cent. Here cases were divided into main and recessive types, 115 in the former and 89 in the latter. Recessive type represents cases of retrogressive lymphoid tissue state, with atrophic change, and thymus tissue frequently changed by fatty replacement. Of extreme importance is the fact that in the recessive type, the greater percentage occurs past the twentieth year. In the Bellevue Hospital report mechanical pressure was not proved in a single patient, and the conclusions base the change on an anaphylactic phenomenon, resulting from liberation of nucleoproteins formed as a result of destruction of innumerable germinal follicles. This excessively liberated "nuclear dust" is comparable to the toxic introduction of alien protein products, and sudden death may be attributable to a state of notably unstable vascular, nervous and lymphatic syndrome; to respiratory center and the effect on it rather than peripheral influence. Simple events, even hypodermic administration may be sufficient to induce the final anaphylactic explosion.

In review of the Bellevue report, one is impressed with the variety of fine detail indications pointing toward hyperplasia and so interpreted which escape ordinary surgical gross necropsy, and raise the thought as to what is primary and what subsidiary in such in the value of deduc-

19. Rehn: Arch. klin. Chir. B, Orig. **80**, 1906.

20. Hedinger: Jahrb. f. Kinderh. B, Orig. **63**, 1906.

21. Symmers, Douglas: The Cause of Sudden Death in Status Lymphaticus, Am. J. Dis. Child. **14**:463 (Dec.) 1917.

tion. With the aid of my assistant, Dr. E. H. Campbell, we have reviewed 1,900 gross adult surgical necropsies and found a surprisingly small total of thymolymphoidal type of cases, hardly a dozen when these fine elements of hyperplastic change were not primarily in the examiner's mind. This critical suggestion however reacts in both directions.

In another series of necropsies at the Children's Hospital, Philadelphia, during the last twenty years, examined for evidence of necropsy status lymphaticus and enlarged thymus indications, that is, elements in examination and history to aid in forewarning against disaster, we find the following. In these cases full record of examination will be omitted. Case numbers are not consecutive but follow chronology in chart record.

ABSTRACT OF CASES

Case 60.—B. F., a boy, aged 6 months, (no necropsy). Status lymphaticus spasm at the age of 1 month, cough, cyanotic spasm 5 months later.

Case 231.—J. B., a boy, aged 8 months. Rachitis, laryngismus stridulus, heavy breathing convulsions.

Case 360.—S. J., a boy, aged 3 years. Daily attacks of dyspnea and cyanosis.

Case 304.—W. C., a boy, aged 9 months, developed inspiratory dyspnea.

Case 306.—E. B., a boy, aged 2 years. Rachitis, rapid breathing, developed cough and vomiting. Waldeyer marked hyperplasia.

Case 244.—G. S., a girl, aged 5 months. Cough since birth, vomiting, spasm, cough and cyanosis, loss of weight.

Case 131.—M. H., a boy, aged 4½ months (no necropsy). Rickets, spleen and liver enlarged. Waldeyer enlargement. Maculopapular rash.

Case 85.—T. M., a girl, aged 6 months. Difficult breathing and vomiting, grunting expiration, liver palpable, cyanosis.

Case 162.—J. J., a girl. Difficult breathing, Waldeyer hypertrophied.

Case 431.—E. T., a boy, aged 4 months (no necropsy). Infantile atrophy, vomiting, cough, diarrhea.

Case 610.—F. F., a boy, aged 6 months. Rachitic, cyanosis, chest and leg deformity.

Case 639.—T. M., a boy, aged 6 years. Frequent sore throat and cold. Died on operating table, operation for tonsil and adenoid.

Case 145.—C. D., a boy, aged 15 months. Convulsions, rachitic.

Case 62.—E. W., a girl, aged 5 months (no necropsy). Laryngitis, cough three weeks.

Case 770.—P. D., a boy. "Wheezing" convulsion.

These fifteen cases give a variety of preliminary death evidences, coughing, cyanosis, difficult breathing. It is obviously a much more difficult problem to interpret such a wide symptomatic field.

The chief facts of importance in the special case are as follows: The patient, a man, came under the care of Dr. L. in Philadelphia, Saturday morning, August 11, with a history of three weeks' illness and treatment by a physician in Atlantic City.

REPORT OF CASE

The patient, H., gave a history of having been ill for about three weeks, and during that time was treated by a physician employed by the company for whom he worked. He had kept steadily at his work during this time in spite of the fact that fever was present daily and worse still at night. He complained of pain in all the tissues of his neck, and examination showed apparent enlargement of what seemed to be the lymphatic glands of the neck tissues. It was possible to outline the submaxillary glands of both sides; the sublingual glands and other lymph glands were prominent. The glands of the right side were more prominent than those of the left and more painful to the touch. The throat examination showed some diffuse but not marked redness. The tonsils were prominent, but in themselves were not acutely disturbed. It appeared as if they were being pushed into the throat from the outside. The tongue was coated, the gums were tender and irritated and the floor of the mouth was slightly elevated and somewhat tense.

Chest examination showed that the heart sounds were rather rapid but no particular disturbance otherwise. He did not complain of difficulty in breathing at that time, nor of any condition in any other part of the body except the neck. The temperature was 102, pulse 112, respirations 28.

The most likely diagnosis which suggested itself was a diffuse adenitis with cellulitis, although there was a possibility of Vincent's or Ludwig's angina. Dr. L. visited the patient on Sunday morning at his home, where he was being attended by one of his friends. He stated that the right side of the neck felt somewhat better, but the left side felt considerably worse, and the examination showed each side to be more prominent than the day before and also quite tender. The temperature had been 103 the evening before and was at that time (10 a. m.) 102. The throat showed further and more intense diffuseness of the redness. The patient only complained of the throat at this time, and an examination of the chest and abdomen revealed nothing different from the previous day. He had slept during the night and also had eaten his liquid breakfast with some enjoyment. Dr. L. continued the treatment and said that it seemed as if he had a peritonsillar abscess on the left side pointing above the soft palate.

I was called on August 13, in the morning, and examined the patient. I found the neck was swollen and tender to pressure on both sides, a kind of a general flat swelling. The patient had been operated on for goiter at a western clinic, and as the temperature was ranging from 101 to 102 F., and no definite evidence to suspect Ludwig's angina, and a very definite evidence of peritonsillar abscess in the throat, a deep peritonsillar incision was made on the painful side. At that time the throat seemed somewhat better, but the tissues of the neck were as tense, as swollen and as painful as before, and the patient had to sit upright or walk around with his head thrown back, and there were audible noises on breathing.

Dr. L. saw the patient several times in the afternoon and reported that he was feeling fairly well; the highest temperature being 102. The neck was still exquisitely tender, there was no trouble breathing but some in swallowing liquids. About 1 a. m., a report came that the patient was breathing deeply, with inspiratory rather than expiratory difficulty. The resident physician reported edema of the neck tissues. Inhalation treatment and ice was ordered. On account of general surgical appearance in the morning Dr. C. was called in. It was Dr. C's. idea that we were dealing with a deep seated collection of pus which could only be reached by an external incision of the tissues of the neck, which was performed later under local anesthesia, but outside of a quantity of serum, nothing was obtained, even though the incision was carried very deeply. Still the patient stated that he felt somewhat better, at least better than while on the operating table. As the emergency element predominated, tracheotomy and other apparatus was prepared. This emergency

came about 11:30 a. m.; a sharp sudden pain developed over the heart, the dyspnea became greater, and in spite of tracheotomy and epinephrin injections, the patient died about noon.

A necropsy was performed by Dr. L. and the resident pathologist.

Quoting freely: the necropsy showed that the heart was perfectly normal in every way. All the valves were examined and found normal. The coronary arteries were examined and found normal. The heart muscle may have been slightly fatty, the auricles were distended with blood to their utmost limit. The lungs were normal in every way, barring a slight injection of the larger bronchial branches. The thymus gland was quite large, more especially the left lobe. The aorta was relatively small in comparison with the large size of the man and the proportionate size of the heart. The lymph glands around the bronchial tree were enlarged and somewhat hardened. This can be said of all the lymph glands throughout the chest and abdomen, and a number of these were examined. In the abdomen, the spleen was very large, probably three times the normal size, and not all of this could be ascribed to the acute inflammatory disturbance. The kidneys were normal in appearance but the right was somewhat redder than the left. There were no cysts, the capsule was not adherent and the proportion of the cortex and medulla were normal. The suprarenal bodies were not enlarged. The abdominal aorta was very small above the point of discission into the ileac, it would not admit the point of a small finger.

The examination of the neck showed no pus at any point. On the right side there was a remnant of thyroid gland rather large in size, and acutely swollen. On the left side there was a mass about 4 inches long and about 2.5 inches in circumference extending upward toward the angle of the jaw. It was recognized as the left lobe of the thyroid, its lower part extended back of the manubrium into the chest. The trachea was compressed by this mass, so that there was a distinct flattening of its left margin. The lymph glands which were apparently enlarged, were found large but not out of proportion to other lymph glands in the body. The greater swelling of the neck was due to the left lobe of the thyroid pushing those glands forward. When incised, it was found to be acutely swollen, with numerous cysts all through it.

The fatal termination was evidently the result of the reddened thymus and the enlargement of the thyroid. It should have been mentioned earlier in the study, that a fine hairline incision along the base of the neck had been explained by the patient to be the result of an operation for the removal of the thyroid gland eight years before. He was evidently of the opinion that the entire thyroid had been removed, and therefore, further thyroid disturbance was never considered in his case.

COMMENT

This patient would possibly have done better with continuance of ice packs and no surgical interference, either internally or externally, yet this was impossible to foresee. The presumptive evidence of peritonsillar involvement, with presence of pus, was indicated by the localized pain, tenderness and tension. The exact cause of death is far from clear.

There was no external evidence of thyroid mass enlargement and history of removal was clearly stated. Time element was also a matter of consideration.

In view of the thymic and lymphoid hyperplasia with thyroid relation, we hoped to obtain more history of such correlation in medical

records than was obtainable. The hyperplasia, hypoplasia, patient's family history and character of death all would seem to have a status lymphaticus suggestion.

The pressure on the trachea and hypoplastic arteries are suggestive but not conclusive evidence of combined pressure and lymphotoxemia. In a varied discussion of the question, a plausible explanation was offered by Dr. Tucker, that perhaps injury or adhesion had occurred to the right recurrent nerve supply in the earlier thyroid operation, producing unilateral cord fixation without aphonia; then when acute involvement occurred on the left side, glottic spasm and secondary pulmonary hypostatic congestion occurred. Final symptomatology would not negate this. Without necropsy, status lymphaticus would have been the verdict.

CONCLUSIONS

1. In the light of published studies, the universal diagnosis of status lymphaticus in cases of sudden unexplainable death is illogical and evasive.

2. Further research as to the intimate tissue change near the time of death would be of great value.

3. The evidence is increasingly toward the pressure element in death from dyspnea and glottic spasm, and away from a distinct pathology.

4. The correlation between neural pressure influence, either direct or reflex, and the intercranial toxemia, as affecting the time element in asphyxia, is particularly obscure.

5. The complex syndrome of factors in lymphatic state would logically explain feeble individual resistance.

ABSTRACT OF DISCUSSION

DR. HARRIS P. MOSHER: In the last year and a half we had four deaths in the Massachusetts General Hospital attributed to status lymphaticus. None of these could we diagnose as being suspected from the facies. None were feminine. I cannot understand that clause in classical textbooks about something feminine in appearance. All of these patients were between 4 and 5 years of age. None of them at necropsy showed that pressure was the probable cause of death. Three of them had enlarged thymus, according to the accepted statements as to what constitutes an enlarged thymus at this age; one child had a normal thymus. All had enlargement of the lymphatics, so that when the abdomen was opened the diagnosis was made of status lymphaticus. Enlargement of the abdominal glands all through the large and small intestine as well as at the base of the tongue, in the pharynx and the enlargement of the lymphaticus was conspicuous. I noted particularly the enlarged tissue at the base of the tonsil, which was a ragged elevation similar to what one sees in the intestinal tract.

It occurred to me to work out a reasonable preoperative history of status lymphaticus. A lot of work has been done on babies. They are born with enlarged thymus, but after 4 or 5 years this has receded. There seems to be some connection between goiter and status lymphaticus. Again, why is there

such close resemblance to the findings of typhoid fever, every symptom, in fact, that goes with typhoid fever except the ulceration? Some change has been going on that produces this similarity; perhaps not a definite organism. The specimens of thymus from three patients are the saddest pathologic specimens I have ever seen. A well child in a few hours was returned to the parents a dead child. At the Massachusetts General Hospital we started the plan of irradiation as routine before tonsillectomy. From 1,400 to 1,450 underwent a roentgen-ray examination. Seventy-one patients, all aged from 4 to 6 years, gave positive signs of thymus enlargement. All these were given the routine therapeutic roentgen-ray treatment and in all the thymus was reduced. Blood count made before and after roentgen-ray treatment showed no change. The lymphocyte count was from 25 to 30. A suspicious increase was found in a majority of these patients, running up to 30 and 40 lymphocytes. We tried the experiment of making a blood count after death; one gave 63 and the other 65 and we made control counts on other patients who had died suddenly. The lymphocyte count in these patients was not increased. The last fatality occurred in a patient where the roentgen ray showed no thymic shadow. The child died of ether narcosis while lying flat. Immediately a roentgenogram was made which showed a large thymus, which meant that the thymus had enlarged since the child's first roentgen-ray examination. I believe that the thymus may undergo sudden alterations in size.

The question arises, what is to be done about it? Shall we make a roentgen-ray examination of all the children, the abdomen with selective roentgen ray, taking the intestinal tract and leaving out the organs in the abdomen? We are going to make roentgenograms of not only the thymus but the abdomen as well. The question of variation in size of the thymus under emotional strain applies to infants and not to children aged 4 or 5 years. I feel that some metabolic process is responsible as there is a similarity between typhoid and status lymphaticus. The out-croppings of tonsils give the impression of magnified lymphoid follicles occurring lower down.

DR. SWAIN: Do you pay attention to the anterior or posterior flattening of the trachea?

DR. MOSHER: No sir.

DR. SWAIN: In the second case which you reported did you apply a stethoscope to the patient?

DR. MOSHER: No; he was breathing naturally and we saw no object in doing so.

DR. SWAIN: I should like to call attention to the flattening of the trachea causing difficult breathing where the roentgen-ray pictures showed the trachea to be unusually broad. We applied suprarenal gland ointment over the surface and found on the roentgenogram that the size of the thymus and the flattening of the trachea had decreased.

DR. DEAN: Is the routine roentgen-ray examination recommended in every case?

DR. MOSHER: It is.

DR. EMIL MAYER: I am much interested in the subject, particularly in connection with the investigation I have been making of deaths from local anesthesia. So often diagnosis of status lymphaticus had been made that I undertook to find out what evidence existed for such a diagnosis. We have long accepted the condition of status lymphaticus as a fact, but there is abundant proof that this has often served as a cloak behind which to hide in case of sudden death. In twenty-three necropsies which had been held in forty odd deaths from local anesthesia, we have obtained full reports of only thirteen, invariably the accounts concluded with the statement that the case was one of status lymphaticus. I sent these full reports of necropsies to Dr. Elliott C. Cutler of the Peter Bent Brigham Hospital. He made a careful study of

each case that was marked status lymphaticus. In addition, Dr. George Norris, pathologist of Bellevue Hospital, also went over the case reports as carefully as I did. In no instance was there any such evidence as Dr. Babbitt has presented that warranted the diagnosis of status lymphaticus. Physicians have been too prone to call the condition one of status lymphaticus provided nothing else can be found. I have seen patients diagnosed before operation as undoubted status lymphaticus, and have seen such patients after ether operation take from three to four days before becoming really clearly conscious. I am sure that had chloroform been used they would have died.

DR. DEAN: In order to prevent serious results in cases of status lymphaticus we have arranged for a conference with the roentgen-ray expert, the pediatrician, the pathologist and the internist. As a result, the following procedure has been outlined: percussion, and ausculatation to determine the size of the thymus. Every suspicious patient is sent to the pediatrician for study before operation.

DR. SWAIN: It was encouraging to see efforts made to obtain the diagnosis of status lymphaticus before operative work was undertaken. I feel that analyses of masses of statistics, such as Mosher has done, should result in some definite advance.

Dr. Babbitt, when you operated on the patient which you thought might be Ludwig's angina, did you obtain nothing but serum? In a patient of my own, a copious serous exudate was obtained but no pus. The patient recovered.

DR. BABBITT: Yes.

DR. BABBITT (in closing): It is my belief that there is a pressure element in cases of trouble with the glottis. The suggestions of Dr. Mosher on the similarity of typhoid is in line with the peculiar state of nonresistance and the tendency to anaphylactic shock when under anesthesia. As to lymphoid recurrences, we see the hypertrophy of lymphoid tissue after tonsillectomy; adenoids also return. This lymphoid recurrence seems to have as a background the status lymphaticus. As regards the question of blood count which Dr. Mosher discussed, we should recognize that much of this change is immediately before or immediately after death. Perhaps something can be gained by the examination of the blood immediately after death.

ACUTE TOXIC MENINGO-ENCEPHALITIS OF OTORHINOGENIC ORIGIN *

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The occurrence of marked cerebral symptoms during the course of an acute infection is not an uncommon observation, that is, in pneumonia, typhoid fever, septicemia, pyemia, otorhinologic suppurations and so forth; it has also been observed in toxemic conditions, such as in uremic and diabetic coma, delirium tremens, alimentary toxicosis, ptomain and other food poisons.

ETIOLOGY

Eliminating from our consideration suppurative meningitis and brain abscess, let us consider briefly some of the acute infections, especially those of otorhinogenic origin, that produce cerebral symptoms without producing gross pathologic evidence of suppurative involvement, either of the brain or of the subarachnoid spaces.

The cerebral symptoms in these cases may simulate the onset of an acute suppurative meningitis, epidemic encephalitis or brain abscess, and often it is only by the frequent use of the lumbar puncture and the examination of the cerebrospinal fluid, that the differential diagnosis can be made.

The onset of an acute suppurative otitis media in infants and children may be announced by a convulsion. Not infrequently, in the course of otologic practice, we have opportunity to observe an infant or young child who is suffering from an acute suppurative otitis media in which some of the early signs of an acute suppurative meningitis are present, namely, rigidity of the neck, and perhaps a positive Kernig or Brudzinski's sign and in which after a paracentesis has been performed there is an immediate relief of the meningitic symptoms. As is well known, meningitic signs may be present in pneumonia and in the upper respiratory tract infections in children without any suppurative meningitis being present, as demonstrated by repeated examinations of the cerebrospinal fluid.

This condition has been termed by the French as "meningisme." It is not a true meningitis and therefore has been termed pseudomeningitis. Meningismus and meningism are other names for the same condition. Oppenheim [1] states that the pathologic anatomy of this condition is essentially that of a serous meningitis or "wet brain" of a very mild

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* From the Otorhinolaryngologic Service of Cook County Hospital.

1. Oppenheim: Textbook of Nervous Diseases, 1911.

type. On necropsy, either no pathologic change or merely edema, hyperemia or possibly serous effusion into the subarachnoid spaces is found. Meningismus differs from serous meningitis in degree rather than in kind. The examination of the cerebrospinal fluid in meningismus shows a normal fluid; while in serous meningitis the fluid is either normal but under increased pressure or abnormal, with globulin present and an increased cell count consisting of lymphocytes and the absence of bacteria. (In every case the spinal fluid should be cultured as the fluid may be clear and yet contain bacteria.)

Quincke,[2] in 1895, was the first to demonstrate the existence of a serous meningitis as a complication of otitis media. Serous meningitis is frequently the result of a localized suppurative external pachymeningitis or extradural abscess.

The following case shows the importance of the examination of the cerebrospinal fluid in the diagnosis of this condition.

REPORT OF CASE

The patient, a boy, aged 11 years, was admitted into Cook County Hospital, with the diagnosis of chronic suppurative otitis media, with an acute exacerbation of twenty-four hours' duration. The physical examination was negative except for the following: the right ear showed pus in the external canal; the posterior half of the drum membrane was absent; the mucosa of the tympanum was red and swollen; there was slight mastoid tenderness (right); the temperature was 103, pulse, 102; respirations, 26; white blood cells, 12,300. Rigidity of the neck and a positive Kernig's sign were present. Spinal puncture showed 12 lymphocytes, and globulin was present. The Wassermann (spinal) test was negative. The ear was kept clean and the discharge was draining well. Spinal punctures were made daily and resulted as follows: 12, 11, 14 and 8 lymphocytes. On the third day after admission the temperature was 103.4 and the patient coughed frequently. On the sixth day, the temperature became normal and all meningitic signs had disappeared. The subsequent course was uneventful.

COMMENT

This was a case of serous meningitis of a mild degree, due to one or both etiologic factors present, namely, a suppurative otitis media and an upper respiratory tract infection. The diagnostic and prognostic assistance of repeated examinations of the spinal fluid were a great aid.

McLean [3] states that in a study of sixty-seven cases of nontuberculous respiratory infections in children, he found that five had a cell count of 30 or more, and four with more than 60 cells per cubic millimeter, and from 90 to 100 per cent. of the cells were lymphocytes. In eight cases of uncomplicated otitis media, he found no change in the cerebrospinal fluid, the highest count being 10 cells and the average

2. Quincke: Samml. klin. Vortr. **138**:313 (July) 1895.

3. McLean, S.: Cerebrospinal Fluid in Infants and Young Children in Conditions Other than Acute Meningitis, Am. J. M. Sc. **166**:35 (Sept.) 1923.

cell count being 5.6 cells. He states that in adults up to 8 cells per cubic millimeters is normal, and that in children as high as 20 cells may be found in a normal child but the normal average was 4 cells.

SYMPTOMS

That the association of serous meningitis per se does not explain all of the cerebral symptoms in the acute toxi-infective conditions is certain. When we have increased intracranial tension as demonstrated by the increase in the intraspinal pressure and symptoms of increased intracranial tension, the meninges are not only affected by the toxins but so also is the brain substance. Therefore, there is present a toxic irritation of the whole central nervous system. As proof of this, we have definite pathologic evidence, that the brain substance is involved in every case of suppurative meningitis, that is, a suppurative meningo-encephalitis is present. Therefore, if an acute serous meningitis and an acute encephalitis are associated and are due to the same etiology, an infectious toxicosis, the combined pathologic process should be known as an acute toxic meningo-encephalitis.

Orr and Rows [4] have demonstrated by clinical, experimental and histologic evidence, that certain infections of the nervous system are due to toxi-infection. They also showed that the lesions of the central nervous system have a definite anatomic relationship with the nerve supply of the peripheral infective areas, and that these lesions depended on toxi diffusion along the perineural lymphatics in addition to the blood-borne infections of the central nervous system.

Gowers [5] noted many years ago, that the presence of contiguous inflammation involving the bone adjacent to the nose and ear is a frequent cause of encephalitis.

Dana [6] states that the acute nonsuppurative encephalitis may be serous or hemorrhagic, that it is characterized by the symptoms of general infection or toxemia of severe cerebral irritation and that it is a rather common condition complicating the infectious fevers of childhood and septic states, otitis media and so forth.

Oppenheim [1] emphasizes the fact that the cerebral symptoms which appear as the result of an acute infection may have either: (1) a purely toxic origin, or (2) a hemorrhagic, embolic or thrombotic basis. All of the symptoms that develop in encephalitis are not based on demonstrable pathologic changes but may be due to toxic injury to the brain

4. Orr, D., and Rows, R. G.: Lymphogenous Infection of the Central Nervous System, Brain **36**:27, 1914; Further Observations on Experimental Toxi-Infections of the Nervous System, ibid. **40**:1, 1917.

5. Gowers: Diseases of the Nervous System, 1903.

6. Dana: Textbook of Nervous Diseases, 1908.

substance. He insists that we must differentiate acute serous meningitis, pseudomeningitis and encephalitis that occur in the acute infections. For all practical purposes, for the otorhinologist at least, this is unnecessary as they may be and usually are part and parcel of the same pathologic process. But of more importance is the necessity for diagnosing the presence or absence of suppurative meningitis or brain abscess. It is also very important to distinguish between the acute toxic encephalitis which is caused by an infective toxicosis due to the presence of an otitic or rhinologic extradural abscess, which when operated on and drained results in the disappearance of the cerebral symptoms. The cerebral symptoms rapidly disappear after the drainage of the otitic or rhinologic focus of suppuration, and if this is delayed too long or not done at all, the patient dies from a complicating meningitis, sinus thrombosis or brain abscess.

CNSET OF DISEASE

The onset of acute toxic meningo-encephalitis may be sudden or gradual; in children it may be ushered in with a convulsion. Headache is usually the first symptom complained of and it is associated with fever. There may be vomiting, vertigo, photophobia and delirium. The delirium is acute and stormy so that the patient may have to be restrained; it is not due to the fever, as the fever may not be very high or indeed it may be absent. The patient is usually very talkative and there may be hallucinations of sight and hearing. The delirium may be replaced by stupor or coma. The patient may be apathetic, but may be aroused and answer questions, or may even be aphasic. Epileptic convulsions may occur early and at all times during the course. As the disease progresses, the deep reflexes become diminished and ultimately the sphincters may become involved. As the symptoms are toxic in origin, they all disappear after the drainage of the focus of septic absorption, which may be immediate or gradual. The convulsions may disappear in from twenty-four to forty-eight hours; the mental condition may require from three to seven days before cerebration is completely restored. If the patient suffers from want of early and efficient surgical drainage, the semicoma continues to deepen and the patient dies from acute toxic meningo-encephalitis or from some intracranial complication such as septic meningitis, sinus thrombosis or brain abscess.

DIAGNOSIS OF SYMPTOMS

It is in these cases that the preoperative diagnosis is the all important factor, as on it depends the method of surgical treatment to be employed. This is of paramount importance, as success or failure in the final outcome will depend on the exercise of surgical judgment based on a correct preoperative diagnosis.

The diagnosis of acute toxic meningo-encephalitis of otorhinologic origin is made as follows: (1) the presence of an otitic or rhinologic infective process, (2) the absence of the essential signs of meningitis or brain abscess, (3) the presence of epileptoid convulsions, delirium, stupor or coma and (4) the examination of the spinal fluid may show (*a*) a normal cerebrospinal fluid, or (*b*) a pathologic fluid, under increased tension, positive globulin, an increased cell count, mostly lymphocytes, approximately from 10 to 100 cells, with bacteria absent.

PATHOLOGIC CONDITIONS

Clinically, we have to differentiate several pathologic conditions in which we have the signs of meningitic muscular rigidity present, namely, rigidity of the neck, Kernig's and Brudzinski's sign and so forth. They can usually be differentiated by an examination of the cerebrospinal fluid.

1. Meningismus, in which we may have the signs of meningitis with a normal spinal fluid.

2. Serous meningitis, in which the spinal fluid is increased in amount, with increased pressure, increase in lymphocytic elements, with globulin positive and bacteria absent.

3. Sympathetic meningitis (Plaut and Schottmuller), in which the spinal fluid is usually under increased pressure, with an increased cell count, variable in amount, usually ranging from 250 to 3,000 cells, mostly of the polymorphonuclear variety. The amount of turbidity present depends on the amount of cells present. The globulin reaction is more marked and bacteria are absent.

4. Acute diffuse suppurative leptomeningitis, in which we find the most marked pathologic findings in the spinal fluid, namely, bacteria may be present and the cellular reaction and globulin test are most marked, the polymorphonuclear cells being increased usually in excess of 3,000.

5. Syphilitic meningitis, in which we may get a positive history, presence of other syphilitic lesions elsewhere in the body, positive findings of cerebrospinal syphilis, a positive Wassermann test, blood or spinal fluid or both, a positive Lange's colloidal gold reaction and the therapeutic test. The spinal fluid shows globulin and an increase in lymphocytes.

6. Tuberculous meningitis, in which we have a clear spinal fluid, containing only lymphocytes. It may contain some small flakes and on standing a cloudy precipitate may form. The examination of the pellicle shows the tubercle bacillus in the majority of cases. In the

absence of the latter, the presence of tuberculosis elsewhere in the body or positive animal inoculation tests.

There is another type of case that is not infrequently met with clinically that will have to be differentiated from an acute toxic meningo-encephalitis, in which there are no signs of meningitis present, but in which the examination of the cerebrospinal fluid shows mild pathologic changes in the cytology and chemistry but is negative bacteriologically. It may or may not be under increased pressure, it is clear or but slightly turbid, globulin is usually present, the cell count is but moderately increased (from 20 to 250 cells) with the lymphocytes predominating. This, we have found, in extradural abscess, brain abscess, cerebrospinal syphilis, epidemic encephalitis and acute toxic meningo-encephalitis. In some of these cases, we may have somnolence, stupor or even coma, which makes the differentiation more confusing.

The following conditions may belong to this type:

1. Epidemic encephalitis, in which we may have the presence of an epidemic to help out. The spinal fluid shows a cell count which is approximately normal or is at least not very high. Barker states that it may range from 10 to 100 cells and consists of small mononuclear lymphocytes. The pressure is normal, globulin is positive and bacteria absent. Lange's colloidal gold reaction is in the syphilitic zone but the Wassermann test is negative. The patient is in a stuporous or lethargic state or may be unconscious. Ocular findings are a frequent accompaniment (diplopia and ptosis) due to an ophthalmoparesis (third, fourth and sixth nerve).

2. Poliomyelitis and polio-encephalitis superior. Here, also, the presence of an epidemic is a great aid in diagnosis. The spinal fluid pressure is increased, globulin is positive and the cell count is increased somewhat over normal. The symptoms and signs found are most important. Increased sensitiveness to handling is usually marked. A lower motor neuron lesion is found, namely, a flaccid limb with loss of reflexes.

3. Brain abscess. The differential diagnosis may be very difficult and is of the greatest importance. Both diseases may have symptoms in common, such as headache, vomiting, convulsions, aphasia, stupor, delayed cerebration and so forth. Brain abscess is usually associated with a sympathetic meningitis, but in some cases the meningitic signs may be absent. It nearly always shows an increased cell count even in the absence of meningitic symptoms. In twelve cases of brain abscess, in which the diagnosis was confirmed either by operation or necropsy, the cell count was less than 400 in 83 per cent. of the patients. Focal signs should be looked for; slow pulse also occurs in brain abscess.

4. Extradural abscess. Meningitic signs are usually absent. The spinal fluid shows the findings of serous meningitis, that is, there is an increased cell count which is low and mostly composed of lymphocytes.

5. Cerebrospinal syphilis. Meningitic signs are usually absent. The spinal fluid is clear with an increased cell count, mostly lymphocytes with a positive Wassermann test and Lange's colloidal gold reaction test (syphilitic type). The globulin and therapeutic tests are positive.

TREATMENT

The treatment is early and adequate drainage of the otorhinologic suppurative disease: (1) in the case without any spinal fluid cellular reaction, simple drainage of the mastoid cells and middle ear, or accessory nasal sinus; (2) in the case with slightly increased lymphocytic cellular elements in the spinal fluid, we expect to find an extradural abscess and therefore a thorough exploration should be made extradurally. The site of predilection of otitic extradural abscess is perisinus or tegmental; in the rhinologic case, it is in the region of the frontal sinus.

Drainage of the extradural focus of septic absorption results in an immediate improvement, which continues to manifest itself until the patient recovers; if, however, the case was one of brain abscess, the improvement would be only temporary, following the drainage incident to the extradural operation, which would be followed by a recurrence of the former symptoms. A marked and continuous reduction of the spinal fluid cell count is the best index of the favorable progress of a case of extradural abscess. In the frequent examination of the spinal fluid, we have a control that is more valuable than the symptomatology as an index of the pathology and necessary treatment in these cases.

We should be careful not to make the mistake of diagnosing a brain abscess when only an acute toxic meningo-encephalitis is present, as the treatment of the former necessitates an intracranial surgical procedure, with the added danger of operating through an already infected field, a procedure which is only justifiable when the diagnosis of a brain abscess is reasonably certain or better still, when it has been made so by exclusion. I have known this unnecessary and unfortunate surgical procedure to cause a secondary brain abscess where none existed primarily and to result fatally from the production of a diffuse septic meningitis.

What is the safest method of procedure, where the spinal fluid shows signs of meningeal irritation? It is important to recognize that the dura mater is the "danger line" and that so long as we keep our surgical procedures external to the dura we are outside of the "danger zone," but if we carry infection through and beyond the dura, when none

is present, we then infect the subdural or subarachnoid space or the brain. Therefore, in these cases, it is expedient to plan a two step operation; first, drainage external to the dura and second, incision of dura and drainage internal to the dura. The first stage will only be needed in an extradural abscess.

CASE REPORTS

CASE 1.—J. L., a man, colored, aged 26, was admitted to hospital Aug. 25, 1924, with the following complaints: right otorrhea, headache, fever, vomiting and convulsions. The patient first complained of right earache, right frontal headache and fever three weeks ago, on account of which he had to quit work and remain more or less in bed. About a week later, he began to complain of pain over the right mastoid. Vomiting began two weeks ago, it was not related to meals and was projectile in type. The otorrhea has been profuse for the last three days. He had had three convulsions, which began two hours before admission.

Physical Examination.—A strong, healthy looking colored man, who was acutely ill, irrational and aphasic was seen. The temperature was 100.2, pulse 84, respiration 24. Except for the presence of a profuse purulent right otorrhea with definite tenderness over the right mastoid, the examination was otherwise negative. Examination of the spinal fluid showed a clear fluid, under slightly increased pressure, globulin absent, with 9 cells (lymphocytes) per cubic millimeter, micro-organisms were absent and culture was sterile. White blood cells, 7,250.

Neurologic examination, made by Dr. G. B. Hassin the day of admission, showed that the condition was due to a toxemia of otogenic infection; that is to say, that the cerebral manifestations, as the aphasia, somnolence, confusion, headache and convulsions were of toxic origin. Signs of a cerebrospinal meningitis or brain abscess were absent. The region of the right mastoid was slightly edematous and very tender, causing the patient to cry out. A mastoiditis was considered as the primary condition and the foregoing cerebral manifestations as secondary.

A simple mastoidectomy was performed the same day. Operative pathology showed acute suppurative mastoiditis involving the pneumatic cells of the mastoid and the zygoma. The dura and lateral sinus were normal.

On the day of admittance and before the operation, it was noted that the patient vomited and had two convulsions, the first of seven minutes' duration, with severe muscular jerking, associated with biting of the tongue and involuntary urination; the second was similar to the first but lasted for nine minutes. The patient was stuporous and did not respond to questions. The temperature varied from 99.4 to 104.8 and the pulse from 82 to 100.

August 26, the first postoperative day, the temperature, pulse, respiration range varied as follows: temperature from 99.4 to 105.4; pulse from 100 to 156, and respiration from 30 to 50. The patient was stuporous and did not respond to questions, was comatose, had seven convulsions of seven, two, three, nine, five, two and five minutes duration. The convulsions involved the muscles of both the upper and lower extremities and the eye muscles. They stopped after a hypodermic injection of morphin ¼ grain and scopolamin, 1/150 grain and did not recur.

August 27, second postoperative day, the temperature was 102, pulse 128, respiration 22. The patient answered questions and seemed restless. White blood cells 9,000.

August 28, third postoperative day. Temperature 100, pulse 100, respiration 20. The patient's mental condition was improving.

August 29, the temperature became normal and remained so. The mental condition returned to normal.

September 7, the patient was discharged from the hospital cured.

COMMENT

The clinical picture was that of meningo-encephalitis, caused by toxemia from acute suppurative mastoiditis, and can conveniently be termed acute toxic meningo-encephalitis. The spinal fluid findings were normal. There was no history of epilepsy.

CASE 2.—I. Z., a boy, age 12 years, was admitted with the following history: the onset occurred five days previously, when the patient became acutely ill with a severe pain over the right eye and root of the nose, which progressively increased in severity and was associated with swelling and redness over the right eye. The patient had a right external frontal sinus operation performed at another hospital after which he rapidly improved until the day before admission, when he became acutely delirious.

The physical examination showed an extremely sick and poorly nourished boy, who was delirious and conscious only at occasional intervals. The essential pathology consisted of redness, swelling and edema of both eyelids, which extended into the soft tissues of the forehead. Some edema was present over most of the anterior part of the scalp, extending over the temporal regions to the zygomatic ridges. Bilateral chemosis was present and also a purulent discharge from the conjunctivae. There was evidence of a recent operation on the right frontal sinus. White blood cells, 27,000. The spinal fluid showed no increase in pressure, a cell count of 52 cells per cubic millimeter, of which 50 were lymphocytes and 2 polymorphonuclears; smear and culture were negative.

Diagnosis—Acute frontal sinus empyema, extradural abscess, orbital cellulitis, cellulitis of the scalp and acute toxic encephalitis.

Operation was performed on Feb. 12, 1924. An incision was made along both eyebrows and across the glabella, the flaps were raised to expose both frontal sinuses, the periosteum covering the sinuses was retracted and the external plate of both frontal sinuses was removed completely. Both frontal sinuses contained much purulent material. The interfrontal septum was removed. The internal plate of the frontal bone was found necrotic and was removed, which corresponded to the area of the frontal sinuses and under which was an extradural abscess. The anterior ethmoid cells were exenterated and the frontonasal duct enlarged. The exposed dura was covered with iodoform gauze and the wound left gaping. Culture from the pus showed staphylococcus.

Postoperative History.—First day after operation the patient was in wild delirium with a temperature of 102. The third day, February 15, neurologic examination by Dr. Hassin showed normal cerebration, no signs of meningitis or brain abscess, only on the right side, there was a mild Kernig's sign present, sensibility and reflexes were normal. The temperature was 100.2, pulse 128, no signs of paralysis or cranial nerve involvement. The delirium and the other cerebral conditions noted were of toxic origin.

The fourth day the temperature was 99, pulse 112 and respiration 32. Sensorium clear, cerebration very good.

The subsequent postoperative history was uneventful and the patient was discharged from the hospital as cured on April 18.

COMMENT

This was a case of acute toxic meningo-encephalitis of rhinogenic origin. The increase in the spinal fluid cell count was due to the presence of an extradural abscess.

CASE 3.—J. K., a boy, aged 10 years, was admitted, Dec. 9, 1924, with the following history: the child had a discharging left ear for three weeks before admittance and was stuporous for the previous week. On admittance, the physical examination showed a fairly well nourished and developed boy who was stuporous but who could be aroused to answer questions and who immediately relapsed into a stupor. Temperature, 100; pulse, 108; respiration, 28. The examination was negative except for a spontaneous horizontal nystagmus, a bilateral congenital ptosis; left otoscopic examination showed the external canal contained a fetid sanguino-seropurulent discharge and a posterior marginal perforation. The spinal fluid showed a cell count of 33 cells, lymphocytes, Pandy and Fehlings tests negative. White blood cells, 11,000.

Diagnosis.—Suppurative otitis media (left), suspected mastoiditis (left), and toxic meningo-encephalitis.

Three days later another examination showed a spontaneous nystagmus was present, which was more marked on looking toward the left, but was not persistent; the left arm showed ataxic movements; spontaneous past pointing was present both inward and outward, but more often the latter; aphasia was absent; the left labyrinth reacted to the caloric test.

Diagnosis.—Cerebellar abscess (left).

Operation.—Exploration of the cerebellum for abscess was negative; the lateral sinus and dura of the middle and posterior fossa were normal; the mastoid was sclerotic.

Postoperative History.—The patient developed a left lower lobe pneumonia on the second postoperative day, and ran a rather stormy clinical course; the temperature became normal on the twenty-fifth day after operation and the patient was discharged from the hospital as improved.

COMMENT

An acute exacerbation of a chronic suppurative otitis media (left) was present, which was responsible for the clinical picture of a toxic meningo-encephalitis. The spinal fluid findings of 33 cells excluded a diffuse meningitis, as did also the absence of meningitic sumptions, but did not exclude an extradural, subdural or brain abscess. Some findings suspicious of a left cerebellar abscess were present but exploration of the cerebellum failed to locate any abscess. This was a case of toxic meningo-encephalitis of otitic origin.

CASE 4.—G. N., a boy, aged 8 years, was admitted, Dec. 12, 1924, with the following history: onset eight days previously, with right otalgia, soon after which the right ear discharged pus freely; seven days before he began to cough and had been coughing ever since; he vomited on the third and fifth days and had several attacks of vertigo not accompanied by tinnitus, nausea or vomiting; delirium was present for the last five days and headache since the day before admittance. He had had fever since the onset eight days previously. History of suppurative otitis media (right) for the past three years.

The physical examination revealed a fairly well nourished and developed boy who appeared acutely ill. He was rational but slightly disoriented as to time and place. Temperature, 102; pulse, 100; respiration, 26. The right ear showed a moderate amount of pus covering the drum; the drum was slightly reddened with bulging in the posterior superior quadrant; the site of perforation was not seen; the left ear drum was also covered with pus, the drum was not bulging, and the site of the perforation was not seen. The lungs showed impaired resonance over the right lower lobe posteriorly, with modified tubular breathing and a few clicking râles. Neck rigidity and

Brudzinski's sign were absent, Kernig's sign was suggestive on both sides, patellar jerks brisk on both sides, Oppenheim and Gordon signs were present on the left but absent on the right side, Babinski absent on both sides. White blood cells, 16,400; 90 per cent. polymorphonuclears. Blood culture was negative; spinal puncture pressure normal, cell count 5 cells, lymphocytes and Pandy negative.

Diagnosis.—An acute exacerbation of a chronic suppurative otitis media (right). Acute suppurative otitis media (left). On account of signs of a right sided cerebral irritation a tentative diagnosis of brain abscess was made.

December 25, the temperature ranged from 97 to 100; the patient complained of being dizzy; was stuporous, irrational and had to be restrained on account of acute delirium.

December 26, the patient had no fever; temperature ranged from 97 to 98; pulse, 60; respiration, 18; patient was stuporous. I made an examination but could not substantiate the previous findings of a right cerebral lesion; pus was found pulsating through a small central perforation in the left drum; following a left paracentesis pus was obtained from the middle ear. Diagnosis: toxic meningo-encephalitis of otitic origin.

December 27, the condition was very much improved, the child had no fever, temperature 98 with a pulse of 60, and the patient was much brighter mentally.

The subsequent history was uneventful; the patient was discharged from the hospital Jan. 7, 1925.

COMMENT

The patient had a meningo-encephalitis of toxi-infectious origin from two foci of infection: otitic, from a bilateral suppurative otitis media and pulmonary, from a lobar pneumonia (resolving), with the evidence in favor of the former as a paracentesis, caused an immediate and marked amelioration of the symptoms. An otitic brain abscess was suspected because of the ill-defined signs of a right sided cerebral irritation together with a bradycardia, vomiting with no relation to food intake and several attacks of vertigo. Fortunately, the spinal fluid was negative and this, together with the mental symptoms, such as restlessness, talking irrationally, stupor and delirium, led to the foregoing diagnosis. This condition shows the great value of negative findings of the cerebrospinal fluid in the presence of symptoms of brain abscess, and is a valuable aid in the differential diagnosis of intracranial complications. The improvement in this patient was so marked and continuous after paracentesis of the membrana tympani that no further operative procedure was indicated.

CONCLUSIONS

The early recognition of acute toxic meningo-encephalitis of otorhinologic origin is important, because the timely drainage of the focus of infection will result in a cure. The preoperative diagnosis of this condition determines immediately the mode of surgical procedure indicated. Otitic brain abscess has not infrequently been mistaken for this condition, a diagnostic error leading to unnecessary and uncalled for intracranial exploration.

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THE CONTRAINDICATIONS TO BRONCHOSCOPY*

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My point of view in this paper is that of the internist who may be called on to decide whether a bronchoscopy is indicated or contraindicated in a given patient. The work of Chevalier Jackson and his pupils has so clearly defined the relation of bronchoscopy to foreign body in the respiratory tract, that I shall omit any reference to that subject. Apart from foreign body work, bronchoscopy has become a valuable procedure in the diagnosis and treatment of many lower respiratory tract lesions. This field of usefulness has been so recently developed that it is well to pause, and endeavor to evaluate at the present time the indications and the contraindications to bronchoscopy. Perhaps I should say skilled bronchoscopy, since with skilled bronchoscopy the indications for its use increase and the contraindications decrease, while in less skilled bronchoscopy the indications decrease and the contraindications increase. To illustrate this point, I wish to refer to a recent report in which a successful bronchoscopy was done under chloroform anesthesia when it could have been done, or at least has been done many times for the same condition by Dr. Jackson and his associates, without an anesthetic. The contraindications to bronchoscopy under general anesthesia are amplified by the contraindications to anesthetics in general. This question of general anesthesia contraindications does not arise when bronchoscopy is practiced in accordance with the Jackson technic.

THE CONTRAINDICATIONS TO BRONCHOSCOPY AS A DIAGNOSTIC PROCEDURE

1. In a patient who has not been carefully studied before contemplating bronchoscopy. By this is meant that a careful history, a complete physical examination, the necessary laboratory studies, and a roentgen-ray examination, both fluoroscopic and stereoscopic, should be performed before resort to bronchoscopy. This having been done, the bronchoscope may help in confirming the diagnosis, may clear a diagnosis otherwise obscure, or may render a diagnosis otherwise not considered.

2. In the presence of aortic aneurysm for obvious reasons. It may be well to point out again that aortic aneurysm not infrequently occurs

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when least expected. It is seldom overlooked when a complete study of the patient has been made. A deep seated aneurysm giving no external signs may produce varying grades of bronchostenosis and bronchiectasis. Unless the possibility of aneurysm be kept in mind, a serious mishap may occur.

3. If there has been a recent hemorrhage. This, however, is subject to individual interpretation as in the following case.

G. H., a woman, aged 24, was admitted to the Jefferson Hospital in January, 1924, for diagnosis. Numerous complete studies had been made prior to admission but no agreement could be reached as to the diagnosis. At first she was thought to be tuberculous and was so treated. Afterward this condition was ruled out. Her history revealed that she had had a fall from a chair four years ago. She struck the right side of the chest but the injury was considered insignificant at the time. Pain in the chest continued and was shortly followed by a cough which became productive. Shortly afterward hemoptysis occurred. During the last two years cough, recurring and severe hemoptyses, progressive weakness and loss of strength with pain in the right side of the chest at the time of the hemoptyses have been the principal features. Physical examination on admission revealed an extensive lesion in the right lung except at the apex, which was clear. This finding, with repeatedly negative sputum examinations for tubercle bacilli, ruled out tuberculosis. Syphilis, and so forth, were excluded, until the diagnosis narrowed itself down to the possibility of a neoplasm. The roentgen ray helped, but was not conclusive. A bronchoscopy was advised in spite of the history of recurring hemorrhages on slight exertion, and the anemic condition of the patient (hemoglobin 30 per cent.). Bronchoscopy, done by Dr. Jackson without untoward effect, revealed a mass of tissue projecting into the right lower lobe bronchus. A small section was removed and histologic examination revealed an adenocarcinoma.

Bronchoscopy confirmed the diagnosis in this case. Intensive roentgen-ray treatments with blood transfusions have resulted in remarkable improvement. It is too early to speak of permanency in the recovery, which at the present time allows the patient to go about as well. She owes her present health to bronchoscopy.

4. If there is active tuberculosis. Patients with active pulmonary tuberculosis should be subjected to none but emergency operations. Here again the individual judgment may favor the performance of a bronchoscopy if the diagnosis of pulmonary tuberculosis is not clear. The following case illustrates this point of view:

H. F., a man, aged 58, came under observation in September, 1924, with a history that three months previous he had been in good health. At that time the present illness began with cough and expectoration, which were diagnosed as acute bronchitis. Two weeks after the onset, the cough became dry and unproductive and shortness of breath was noticed. Since that time distressing unproductive cough, dyspnea, weakness, fever and occasional night sweats with progressive loss of weight have developed. He was referred with the diagnosis of advanced pulmonary tuberculosis. No sputum examination had been made because of the absence of expectoration. On physical examination at the hospital, it was evident that a lesion unlike that of tuberculosis was present. There were signs of extensive involvement of the right lung. Displacement of the trachea toward the left side suggested pressure. Retraction in the right lower side of the chest with moderate displacement of the heart to the right and distant breath sounds suggested contraction of

the lower portions of the right lung or perhaps collapse. It seemed likely that a neoplasm involving the right main stem bronchus was present. Such a lesion could produce displacement of the trachea and occlusion of the bronchial lumen with collapse below. Aneurysm was thought of, but all the features of the case suggested the greater likelihood of neoplasm. A roentgen-ray examination was made by Dr. Bowen, who corroborated this opinion. Dr. Clerf, of the Bronchoscopic Clinic, was asked to see the patient. The history, physical findings, roentgen-ray studies, and so forth, were placed before him with the recommendation that a diagnostic bronchoscopy be performed. Dr. Clerf found the right main stem bronchus occluded with tissue resembling neoplastic tissue, a small section of which was removed and sent to the laboratory where Dr. Crowell and Dr. Crawford made a histologic diagnosis of malignancy. Unfortunately in this patient the diagnosis did not prevent his ultimate death, but it did prevent a useless trip to a sanatorium, which was in contemplation when the diagnosis of tuberculosis was entertained. That the early recognition of endobronchial tumor with removal may result in recovery, is illustrated by the case reported by Jackson many years ago.

5. Bronchoscopy is contraindicated in moribund patients. This seemingly obvious fact would not find mention here if it were not for the fact that a number of such patients have been referred obviously too late for bronchoscopy to be of any value diagnostically or therapeutically.

THE CONTRAINDICATIONS TO BRONCHOSCOPY AS A THERAPEUTIC PROCEDURE

The contraindications to bronchoscopy as a therapeutic procedure can be understood better if one recalls that its ideal indication is to facilitate drainage of localized lung suppuration, when such a lesion is near to and communicating with the tracheobronchial tree. Localized lung abscess and localized bronchiectasis (unassociated with active tuberculosis) come within this category. Patients who have recently become ill do better than those with longstanding conditions for obvious reasons. The contraindications to bronchoscopy in lung suppuration, therefore, are (1) purulent pneumonia, or that suppurative lung lesion like purulent pneumonia, which precedes the formation of an abscess, (2) multiple abscess formation, (3) extensive bronchiectasis, that is, involving the whole lung or greater part of both lungs, (4) localized abscess near the periphery of the lung, which unlikely to drain satisfactorily through the tracheobronchial tubular system, can readily be drained by a surgical operation.

5. Bronchoscopy is contraindicated in the localized bronchiectasis associated with the marked distortion of structures when that lesion is associated with marked fibrosis. I say it is contraindicated if it is done with the expectation to cure. If it is done with the hope of giving relief to the annoying offensive and fetid expectoration, and to improve the general condition by lessening the toxemia which follows when the bronchiectatic area is kept clean, then there is no contraindication in

bronchiectasis, even of long standing. Such patients frequently approach a clinical recovery. Furthermore, I am convinced that the aggravation of bronchiectasis in many cases as the years go by, is dependent on the constant presence of a residuum of fetid material which is never completely evacuated, except by bronchoscopic aspiration.

6. Bronchoscopy is contraindicated in the presence of marked cardiac weakness. This condition, involving especially the right side of the heart, is not uncommon in longstanding cases of pulmonary fibrosis and bronchiectasis.

7. Bronchoscopy is contraindicated in the presence of a serious complication in a patient whose pulmonary lesion would indicate its use. Several examples are (1) a patient with chronic abscess, who developed a fatal pneumonia of the opposite side; (2) a patient with localized bronchiectasis in the right lower lobe, who had a headache with fever for several weeks. Under observation, it became evident that he was developing a brain abscess, from which he eventually died; (3) two patients with associated pleural lesions, one an empyema and the other a pyopneumothorax; (4) finally, a patient whose symptoms and signs suggested a perforative empyema. A large purulent effusion was finding slow exit by way of the tracheobronchial tree. I was asked by the attending physician if bronchoscopy would facilitate drainage. The patient was referred to a surgeon and ultimately recovered after the usual rib resection and drainage. Many more examples could be given of unsuitable cases for bronchoscopy.

COMMENT

The most ardent enthusiast, and I am one, of the value of bronchoscopy in the diagnosis and treatment of lung lesions other than those associated with foreign bodies, learns that there are definite contraindications, which if overlooked will discredit an invaluable procedure. The indications for bronchoscopy outnumber the contraindications. The procedure will be more widely used when all medical men realize its safety in skilled hands. Our working rule is this: when in doubt if there are no clear contraindications, give the patient the benefit of a bronchoscopic examination.

It has been my privilege to witness the use of bronchoscopy in many nonforeign body cases without a single untoward effect, either as a result of the procedure per se, the insufflation of bismuth, the introduction of medicaments, the removal of tissue for biopsy, the aspiration of secretions, and so forth. This experience attests the value of skilled bronchoscopy in suitably selected cases.

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THE NATURE OF THE IMPULSE WHICH AFFECTS THE CRISTA AMPULLARIS OF THE SEMI-CIRCULAR CANALS

A PRELIMINARY REPORT

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Since the first anatomic investigations of the endolymph and of the labyrinthine canals in the human ear by Schellhammer,[1] Cotugno[2] and Meckel[3] in the latter part of the seventeenth and early eighteenth centuries, discussion of the functions of this apparatus has been a favorite theme for physiologists. Although Boerhaave[4] had theorized on the functions of the semicircular canals, it was Flourens[5] first, in 1824, by his experimental work, marvellous when we consider the time and the conditions, who laid the foundations for a true knowledge of the connections between equilibrium, head movements and integrity of the canals. This work directed immediate attention to the importance of excitation of the semicircular canals in the study of equilibrium and orientation, and opened a new chapter in physiology.

In this paper I wish to make a short preliminary report of some experimental investigations which I have made, regarding the method in which the nerve apparatus of the semi-circular canals and their connections become excited; but before describing this work, it will perhaps make the subject somewhat clearer to survey briefly the views that have been held up to the present time regarding the nature of this nervous impulse.

REVIEW OF THE LITERATURE

Goltz[6] was the first in 1870 to enunciate his theory of hydrostatic pressure of the endolymph, with consequent ampullar nerve excitation, the pressure varying with different positions of the head. This pressure

1. Schellhammer: De auditu. Lugduni Batavorum, 1684 (cited by Maier and Lion).

2. Cotungo: Anatomica dissertatione, Vienna, 1774.

3. Meckel: Dissertatio anatomica physiologica de labyrinthi auris, May, 1777.

4. Boerhaave: Praelectiones Academicae in proprias institutiones rei medicae, Goettingen, A. Haller, 1739, p. 43.

5. Flourens: Recherches experimentales sur les proprietes et les fonetionis du systeme nerveuse, Mém. Acad. roy. d. sc. Paris **12**, 1824.

6. Goltz: Ueber die physiologische Bedeuting d. Bogengange des Ohrlabyrinthes, Arch. f. d. ges. Physiol. **3**, 1870.

theory was soon challenged by Breuer,[7] Mach [8] and Crum-Brown.[9] These investigators, after independent research work, formulated the theory that rotatory head movements caused a flow in the endolymph within the semicircular canals, which set up a neural excitation of the cilia in the ampullar enlargement.

The view was also expressed that the ampullae and semicircular canals are the organs for the dynamic function of equilibrium, and the otoliths for the static functions. It was assumed that rotation of the head in the plane of a canal, by the inertia of the endolymph, caused a current within the canal contrary to the direction of rotation which stimulated the crista ampullaris.

This is the hydrodynamic theory which, with some exceptions, has been generally accepted to the present time. The theory received great support from the later findings that caloric and electrical excitations, applied from the tympanic membrane, produced endolymph movements as well as rotation of the head, and that well defined eye movements (nystagmus) accompanied all three phenomena. When caloric irritation was applied to the external ear, it was assumed that there was a physical transmission of heat to the semicircular canal fluid.

An important difference between the temperature of the external source of heat and that of the labyrinth was not necessary, as Demetriades and Meyer [10] and Kobrac [11] showed that caloric nystagmus could be produced by a comparatively slight variation from the temperature within the labyrinth, or rather by a comparatively small change in the heat condition of the external ear. Kobrac believed that caloric irritation caused a change in the volume of the blood vessels, which again gave rise to a flow of endolymph.

Barany's [12] theory, on which the caloric test that bears his name was based, assumes movement of the endolymph provoked by thermic variations transmitted from the external ear to this fluid, this movement exciting the crista and causing nystagmus. Convection currents are formed, due to changes in the specific weight of the endolymph.

Besides rotation and the application of heat, it has been observed that the passage of a galvanic current through the system of the semicircular canals by unipolar and mono-auricular application produces

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7. Breuer: Sitzungsb. Akad. d. Wissensch. Wien. **112,** 1902.
8. Mach: Ueber die Gleichgewichtsinn. Sitzungsb. Berl. Akad. d. Wissensch., Wien. Math. Nat. Klasse, **49,** 1874.
9. Crum-Brown: On the Sense of Rotation and the Anatomy and Physiology of the Semicircular Canals, Proc. Roy. Soc., Edinburgh **8,** 1874.
10. Demetriades and Meyer: Monatschr. f. Ohrenh. **46**:451, 1922.
11. Kobrac: Beitrag zur Lehre von den statischen Nystagmus, Berlin, 1922.
12. Barany: Monatschr. f. Ohrenh. **43**:191, 1906.

nystagmic reactions, as well as reaction of the limbs and body in harmony with nystagmus. If nystagmus has already been otherwise produced, it will be intensified by such a current. Molinie,[13] however, considers that since nystagmus ceases on cessation of the current, the condition was not due to endolymph movement but rather to direct excitation of the vestibular nerve.

We, therefore, have two main theories regarding ampullar nerve excitation and consequent nystagmus, the first claiming that it is due to circulation of the endolymph, the second that it is due to pressure exerted by this fluid on the nerve endings. The circulation theory assumes that during positive or negative angular acceleration of the head, the endolymph should undergo a certain displacement in respect to the walls of the semicircular canals and the ampulla, this movement acting as a nerve stimulus to the receptors in the crista ampullaris and that the direction of the endolymph current determines the nature of the afferent impulse.

I might here refer to the view of Griessmann,[14] who regards the labyrinth as a nervous apparatus particularly sensitive to heat and cold, the caloric reaction being due to this rather than to endolymph movements of vasomotor phenomena. A number of experimental investigations have been made either to confirm or refute these theories.

The main objection to the pressure theory is that a change of pressure without movement is impossible, so that this theory reduces to one of mass movement.

The objections raised against the theory of endolymph movement in the canals acting as a nerve stimulus are:

1. That it assumes extreme sensitiveness of the nerves involved in the preception of a very slight circulation.

2. That capillarity in canals with such small caliber as the semicircular canals would overcome the tendency to movement of the endolymph.

3. That pressure transmission alone without mass movements would not suffice to account for nerve stimulation.

The methods followed in these experimental investigations have been either to construct models approximating the formation of the labyrinth and observe the behavior of viscous fluids with which they were filled when physically, electrically or dynamically acted on; or else to experiment directly on animals by elimination of either the labyrinth or by severance of its nerve connections.

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13. Molinie: Ann. d. mal. d'oreilles, du larynx, **41**:740, 1922.
14. Griessmann: München. med. Wchnschr. **68**:1648, 1921.

Ewald,[15] in early experiments on pigeons, showed that the semicircular canals could be cut, plugged, ligated or even moved out of their normal planes for experimental purposes. He used a pneumatic hammer for external excitation.

Borries,[16] who extirpated the semicircular canals in pigeons and still obtained caloric nystagmus, reasoned that the nerve stimulus for caloric nystagmus originated in the otoliths, namely, in the maculae rather than in the cristae ampullaris. Klein and Lund [17] find that it originates in the semicircular canals, that is, in the crista.

Maxwell's [18] work, on the otoliths of fishes, established for him that the various eye movements accompanying bodily rotation could be produced by applying pressure or tension to the nerve region of the membranous labyrinth. The nerve stimulus may arise either from circulation in the enlarged portion of the labyrinth, or from changes of tension produced by inertia displacement under acceleration. Maxwell denies that temperature differences can cause convection currents in the semicircular canals.

Maxwell's experiments showed him that:

> When the head performs a rotational movement, the inertia of the mass of liquid in the vestibule exerts a pull upon the attachment of the membraneous canal to the utriculus and the tension is communicated to the crista. Cutting the canal between the ampulla and the vestibule puts the ampulla completely out of function, but cutting the canal on the other side of the ampulla does not in the least interfere with its activity. This fact alone would show that the normal stimulus of the crista is not an endolymph current in the canal.

Maxwell's work, according to Heyl,[19] definitely located the mechanism of equilibrium in the enlarged portion of the labyrinth rather than in the constricted canals. The nerve stimulus may arise either from circulation in these enlarged portions or from change of tension produced by inertia displacement under acceleration.

Maxwell's experiments showed that either the canals and ampulla or the otoliths (but not both), could be removed without destroying the compensatory movements in the eyes.

Maxwell thinks that a movement of endolymph possibly takes place through the semicircular canals, not as a stimulus to the nerve endings in cristae but as a means of equalization of pressure.

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15. Ewald: Zur Physiologie des Bogengange. Arch. f. d. ges. Physiol. **41**:1818.

16. Borries, G. V. T.: Studien over Vestibular Nystagmus, Copenhagen, 1920; Acta Otolaryngol. **3**:339, 1923.

17. Klein and Lund: Arch. f. d. ges. Physiol. **186**:6, 1921.

18. Maxwell, S. S.: J. Gen. Physiol. **2**:123, 1919; ibid. **3**:157, 1920; Tr. Am. Otol. Soc. **16**:229, 1922.

19. Heyl: Tr. Am. Otol. Soc. **16**:219, 1922.

Meurman [20] recently made investigations on the labyrinthine apparatus of cadavers. A thermo-element was introduced into the labyrinth, as far as the neighborhood of the ampulla of the horizontal semicircular canal. This was connected with a mirror galvanometer, the labyrinth filled with a viscous fluid and then sealed. Water differing in temperature from that of the head was then dashed against the tympanic membrane, and the observer at the galvanometer marked the movement when movement took place in the labyrinthine fluid. Meurman found that even with minimal caloric irritation against the external ear, a fluctuation of warmth could be observed in the labyrinthine fluid sufficient to cause motion. Meurman did not observe the velocity of movement in the labyrinthine fluid which he assumes. Meurman is of the opinion that it is probable and plausible that even an extremely slight movement in the endolymph is able to cause an irritation of the peripheral apparatus of sense.

Cemach and Kestenbaum's [21] recent experimental work has shown that alabyrinthine subjects have the sense of rotation as well as those with the labyrinth intact, and that gyratory nystagmus is not due to labyrinthine irritation.

These authors consider that rotatory movement is the true excitant of endolymph movement within the labyrinth.

Blumenthal's [22] investigations also show that caloric excitation is not a physiologic excitant for the labyrinth, while rotation is. Calorization acts by exciting the vasomotors of the conduit and indirectly the labyrinth.

Maier and Lion [23] have shown that in a model of the human semicircular canals, inertia currents can be produced, which currents they assume to be an adequate stimulus of the cristae ampullaris. They also demonstrated endolymph movement, following a minimal caloric excitation of the external ear of a pigeon.

Rossi's [24] model experiments supported the Mach-Breuer theory of endolymph movement, as also did those of Schilling [25] and Gaede.[26] From model experiments carried out under the direction of the U. S. Bureau of Standards, it was concluded that no appreciable circulation of liquid takes place in the semicircular canal under the conditions of speed and eccentricity as usually applied.

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20. Meurman: Acta Otolaryngol., Stockholm, **6**:555, 1924.
21. Cemach and Kestenbaum: Monatschr. f. Ohrenh. **57**:137, 1923.
22. Blumenthal: Arch. f. Ohrenh. **107**:1, 1921.
23. Maier, M., and Lion, H.: Arch. f. d. ges. Physiol. **87**:47, 1921.
24. Rossi: Arch. ital. d'anat. **18**: Supp. 298, 1922.
25. Schilling: Arch. f. Ohrenh. **110**:1, 1922.
26. Gaede: Arch. f. Ohrenh. **110**:6, 1922.

In model experiments by Jones and Ingham,[27] these authors, by heating the ends of the model, showed the existence of movement of fluid, the direction of the movement varying with the end at which heat was applied.

Jones and Ingham consider that in the semicircular canals capillary resistance does not prevent mass movement when the tube is in free communication with a common reservoir.

COMMENT

It is hardly necessary to recapitulate the essential facts observed by the various investigators to whom I have alluded, in regard to the reactions of the labyrinth to caloric, rotational and galvanic influence. The constant experimental work pursued, as made evident by the abundant literature, suffices to show that none of the theories put forward are acceptable as solving the problem of the nature of the impulse which excites the labyrinthine nerve endings. There are strong and valid reasons, based on the facts of physics, which make it difficult to accept as final the theory that endolymph movement is the impulse for nervous excitation. The modified form of this theory, namely, the concept that stimulation of the crista ampullaris is the result of changing pressure of the endolymph against the end-organ is hardly tenable.

In view of the unsatisfactory aspect of the conception of endolymph movement or pressure acting as nerve stimuli, as well as our incomplete knowledge whether such movement actually takes place, would it not be pertinent to seek some other explanation to account for the reaction of the labyrinth? Why should it be necessary to postulate endolymph movement or molecular pressure, when other physical agencies might more adequately explain the findings observed in the clinical laboratory? Might not, for instance, the phenomenon be an electrical one? It is a significant fact that the vestibular nerve, as pointed out by Molinie,[13] can be directly excited by a galvanic current acting through the external ear and it would seem plausible to surmise that heat, cold or rotation phenomena would be capable of originating certain electrical changes within the labyrinth, and that such electrical changes would act as the stimulus which influences the end-organ and results in the well known phenomena of vestibular activity.

In order to test this theory I have carried out certain experiments.

First Series.—A glass model of a semicircular canal was constructed. Two small wires, one from each end of the canal were connected with a micromilammeter, an instrument for measuring small quantities of electrical current. The canal was filled with water in which a small amount of sodium chlorid was dissolved. One end of each of the two wires was immersed in this solu-

27. Jones and Ingham: Tr. Am. Otol. Soc. **16**:151, 1922.

tion. The other two ends were connected with the milammeter. Under these conditions observation of the milammeter showed that there was no electrical current within this circuit.

When the ampullar end of the canal was heated, the indicator on the milammeter soon showed the presence of an electrical current flowing in one direction. When the ampullar end was chilled, an electrical current flowing in the opposite direction was observed.

Second Series.—Another model (large scale) of a semicircular canal was constructed, into the ampullar end of which a fine platinum wire was sealed, the end of the wire projecting into the ampulla. In a similar way another platinum wire was sealed into the other end of the canal. The canal was filled with a 1 per cent. sodium chlorid solution. These two wires were again connected with the milammeter, which showed no deflection of the indicator. The wires were then disconnected from the milammeter, and the model was mounted horizontally in a slow centrifuge and rotated. At the end of rotation the wires were again connected with the milammeter, which immediately indicated the presence of an electrical current in the solution. Rotation of the model in a direction opposite to the first showed on the milammeter a reversal of the current first observed.

INTERPRETATION AND APPLICATION OF EXPERIMENTAL FINDINGS

I am aware that the mere contact of a metallic wire in a salt solution (electrolyte), even if unheated, at times suffices to set up a momentary movement of dissociated ions in the electrolyte, that is to say, an electric current. But such was not the case in my first series of experiments, as no current was indicated on the milammeter. The fact that a current was observed within the canal fluid when heated at one end, and that the direction of the current varied according to the end at which the heat was applied showed without the least doubt that the current was a function of the temperature change. It is a well-known physical fact that heated bodies are unable to retain electric charges and that thermionic currents are set up, namely, currents from a heated body. In the present experiments, the heated sodium chlorid solution is dissociated into negatively and positively charged ions, that is, the sodium and chlorin ions. These ions have different migration velocities in a given fluid. Differences in the concentration of ions brought about by differences in their migration velocities constitute the source of differences in electrical potential, such difference of potential resulting in a current.

The laws of physics entirely suffice for the creation of an electrical current within a heated electrolyte.

Furthermore, if the dynamic force of heat can sort these ions, centrifugal and centripetal force can likewise dynamically sort them. The sodium ion is lighter in weight than the chlorin ion in the proportion of their atomic weights, twenty-three to thirty-five. On centrifuging the solution, as in the second series of experiments, the heavier chlorin ions have a tendency to lag behind the lighter sodium ions; there is thus a partial sorting of the ions, namely, the heavier ones at one end and the

lighter ones at the other end. The immediate result of this sorting of the ions create as before a difference of relative potential, that is, an electric current.

Although the foregoing explanation of the creation of the electric current may not withstand criticism, yet the fact remains that an electric current is actually created and it is a logical inference that the phenomena in the human labyrinth is exactly of the same kind, namely, that heat reaching the endolymph (electrolyte) dissociates its ions, and that an electric current is created in the endolymph which is an adequate stimulus of the crista ampullaris.

A more detailed report will be made later when further investigations have been completed, relating particularly to the so-called "fistula symptom."

DIPHTHERIA OF THE EAR*

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REVIEW OF THE LITERATURE

The word diphtheria was first used by Bretonneau [1] in 1855, although historically the disease was first described by Aretaeus [2] of Cappadocia in the second century. About this time it was also described by Galen.[3] Aetius in the fifth century was familiar with the condition. Epidemics occurred throughout the middle ages, and it still remains a highly contagious disease.

The presence of the Klebs-Loeffler bacillus (1883) is the etiologic criterion by which true diphtheria is distinguished from other forms of membranous inflammation. However, the presence of this bacillus in the absence of histologic examination demonstrating its relation to the process, is insufficient evidence of an etiologic relation It is of interest that most cases of diphtheria will show no clinical evidence of ear trouble.

While otitis media of diphtheritic origin can scarcely be considered a rare condition, the literature on this subject is not profuse and it has seemed worth while to make a brief critical summary of the reported cases. The selection of the earlier ones was made from the case histories. As animal inoculation is essential for determining the true character of the infection, many of the earlier diagnoses are not conclusive. To this summary of the literature we add two cases of diphtheria in children which came under my personal observation.

The earliest record that I have found is from Wreden,[4] who observed diphtheria of the middle ear during life, two in nurslings, and also as a sequel of scarlet fever, with nose or throat diphtheria, eighteen times in children, aged from 4 to 15 years. Ten of the patients were very deaf both by air and bone conduction, while only three complained of pain in the ear. Facial paralysis occurred in twelve, one of which was bilateral. In half of them the tympanic membrane was destroyed. In three the membrane extended to the auricle. Wreden states that it ordinarily sloughs in from three to six days followed by much pus. The hearing then improves and the patients have a lower temperature than is usual in diphtheria. The duration is from four to nine weeks, the

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* Contributions from The Evans Memorial, No. 73, A-35.

1. Bretonneau: Arch. gen. de Med. (Memoir 5) 1855.
2. Aretaeus: De Causis et Sigis Acutorum Morborum, **1**:9 (not read).
3. Galen: De Locis Affectis, **1**:9 (not read).
4. Wreden, R.: Ztschr. f. Ohrenh. **2**:48, 1868.

exudative period from one to two weeks. In rare cases the condition may become chronic and last for years.

In Wendt's [5] series of case reports of diphtheria of the ear, he demonstrated it in one-fifth of all cases of croup and diphtheria, and in two-fifths of the cases in which the nasopharyngeal space was affected. The cavity of the tympanum was the seat of hyperemia and hemorrhage, of catarrhal or suppurative inflammation. In one patient diphtheritic membrane was found only in the external ear, on the membrane of the middle ear cavity, on the ossicles and in the cells of the mastoid process.

Burckhardt-Merian [6] says the severe forms of suppurative inflammation of the middle ear in scarlet fever is always the result of diphtheritic processes, to which also the very rapid disintegration of the tympanic membrane is to be attributed. Councilman [7] states that in measles or scarlet fever, a sequential diphtheritic infection is accidental, as is the case with erysipelas or with other pus organisms.

Lewin [8] states that only half of his patients showed purulence, and only a few exhibited destruction of the middle ear and bone. The intensity of the middle ear process is not gaged by clinical symptoms. True Klebs-Loeffler middle ear disease has no serious clinical symptoms, but a more severe anatomic picture. The inner ear is usually normal, but when involved the eighth nerve is usually affected. He describes sixty cases, fifty-seven with throat findings, one nasal, one skin, one eye. The ages varied from 8 months to 32 years. The duration was from two to thirty-nine days. Of the sixty patients, twenty-two showed chronic catarrhal changes, thirty were bilateral. Subjective symptoms were usually absent, while in no case was there spontaneous rupture of the drum. Loss of hearing was observed in twelve cases.

In the discussion of Haskin's [9] case, Perkins states there were four cases in Dench's clinic in mastoid wounds. No antitoxin was given, but alcohol and bichlorid dressings were used. There were no symptoms of systemic infection, although one of the house officers contracted diphtheria in caring for the patients. Curtis cited a patient of his who had an antrum infection, followed by the development of an ear showing symptoms of diphtheria. Ard cited a case with diphtheria of the ear in which antitoxin was given, but a double mastoid operation proved necessary. Mulholland mentioned that he had twelve cases in children under observation at the New York Foundling Hospital.

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5. Wendt, Hermann: Arch. d. Heilk. **11**:258, 1870.
6. Burckhardt-Merian, Alb.: Klin. Vortr. **182**, (Series 7) 1880.
7. Councilman, W. T.: M. Sc. **11**, (Series 106) 1893.
8. Lewin, Leon: Arch. f. Ohrenh. **53**:1, 1901.
9. Haskin, W. H.: Ann. Otol., Rhinol. & Laryngol. **23**:450, 1914.

In the discussion of Vinsonhaler's [10] cases, Patton mentioned a patient of his who had had three operations on the mastoid, but which had never healed. Finally he did a radical operation, and four weeks later in a positive culture of Klebs-Loeffler bacilli identified the cause of delayed union.

Kobrak [11] believes with Lewin that these cases may show only purulency. He states that to prove a case primary of the ear, it must be demonstrated that there is an absence both clinically and bacteriologically of the disease in the respiratory tract.

Benesi [12] considers that diphtheria bacilli are secondary to bacteria causing chronic inflammations of the middle ear.

Von Szász [13] states that he believes external infection of the ear is brought about by close living quarters, infected linen, cotton swabs and that the fingers scratch the skin, breaking it, thus permitting the external infection.

Wotzilka [14] takes exceptions to von Szász's reasons, stating that in primary diphtheria of the auditory canal, it is striking that the virulent diphtheria bacilli which lead to necrosis do not impair the site of predilection of diphtheria. There is also a lack of the general symptoms of diphtheritic intoxication. He also believes that the presence of diphtheria bacilli in acute and chronic middle ear infection is more common than most observers think.

In the case histories of this series, forty-two necropsies are reported. Eight of the deaths were due to pneumonia. One patient had caries of the spine. Three had thrombosis of the jugular vein. Two of them had tracheotomy performed for laryngeal complications. Three had meningitis.

Lommel [15] states that he believes that otitis media forms a part of the clinical fiction of diphtheritic inflammation of the respiratory tract. Among all his necropsies, but one patient, Case *22*, showed a normal middle ear, while in the remaining twenty-four all gave indications of participating middle ears. He notes that in his series the disease was rarely diagnosed intra vitam. He explains this by the fact that the onset of the ear disease was, as a rule, free from pronounced symptoms, and that in none of the cases was there a perforation of the drum, through which pus might discharge. Also, most of the patients were too young

10. Vinsonhaler, F.: South. M. J. **9**:839, 1916.
11. Kobrak, Franz: Ztschr. f. Ohrenh. **59**:295, 1909.
12. Benesi, O.: Wien. klin. Wchnschr. **25**:1385, 1912.
13. Von Szász, T.: Wien. klin. Wchnschr. **27**:756, 1918.
14. Wotzilka: Wien. klin. Wchnschr. **34**:945, 1918.
15. Lommel, E.: Arch. Otol. **26**: 1896.

to make their trouble known. In four of the cases of the series the secretion was nonpurulent.

McCollom,[16] in a clinical study of 800 cases, of which 121 were fatal, observed in this latter group a discharge from the ear seven times. He believed this to be a smaller number than would generally be observed. In quite a number of patients, where there had been no symptom referable to the ear before death, membrane was found in the middle ear at necropsy. He noted that where there was a profuse nasal discharge in nearly every instance at the examination, membrane was found in the middle ear.

Councilman,[7] Mallory and Pearce [17] examined 144 fatal cases. The diphtheria bacilli were seldom found in pure culture, but usually in connection with one or more other organisms. In only twenty-three patients was the disease recognized during life. In forty-four the exudate was purulent, and in thirty-six of these, diphtheria bacilli occurred nineteen times. Of these 144 patients, eighty-six had middle ear involvement.

Pearce [17] subsequently examined a series of ninety-four cases, of which thirty-two patients showed involvement of the middle ear or mastoid. In another group (complications), there were forty-six examined showing diphtheria in twenty. Eleven of the latter showed diphtheria in both ears. This series was tested through animals for positive proof of virulency.

Forbes,[18] in examining postscarlatina ear, found diphtheria bacilli with surprising frequency (in thirty-two out of forty patients). Ordinarily diphtheria bacilli appeared only after the condition had continued several days. Apparently the patient was in no danger of faucial diphtheria. He believed that there was metastasis of scarlatinal affection to the ear, with a secondary infection by the diphtheria bacillus.

It is a noteworthy fact [19] that, in infants and young children, otitis media occurring in the course of diphtheria may work serious destruction in the tympanic cavity without perforating the tympanic membrane. Thus the ear involvement may be overlooked entirely. Genuine diphtheritic membranes are often formed in the middle ear. Extensive necrosis of the osseous parts of the auditory canal (auricular ossicles, mastoid process, temporal bone and labyrinth), and endocranial complications may develop in grave cases. Spreading of the suppurative inflammation to the labyrinth [20] will cause almost total loss of hearing and produce all the other symptoms of panotitis.

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16. McCollum, J. H.: Report of Boston City Hospital, Series 9, Boston, 1898.
17. Pearce, R. M.: Report B. C. H., Series 9, Boston, 1898.
18. Forbes: J. Path. & Bacteriol. **8**:448, 1903.
19. Alexander, Gustav: Diseases of the Ear, pp. 159, 168; Grünert, K.: Arch. f. Ohrenh. **60**:125, 161, 1904.
20. Urbantschitsh, V.: Lehrb. d. Ohrenh. **5**:493.

OTITIS EXTERNA

The diphtheritic form of diffuse otitis externa is very rare. According to the keenest observers,[21] it is never a primary condition, but rather an occurrence in the latter stages of the inflammatory process. This form of the disease is usually found in scrofulous subjects, in whom the original inflammation has been either neglected or improperly treated. In such cases, after the usual purulent discharge has lasted an indefinite time, there is a sudden increase of pain and fever. Simultaneously a white diphtheritic membrane appears, which adheres most closely to the inflamed structure, and even when lightly touched causes intense pain and some bleeding of the parts beneath.

In children there is often found at the termination of an attack of diphtheria an inflammation in the external ear. In some this rapidly extends directly to the bone of the canal and backward to the mastoid. These inflammations, usually deep seated in the anatomic sense, are either caused by the bacillus pyocyaneous, or are severe acute or chronic streptococcic infections of the middle ear. Pain is not a prominent symptom in these inflammations following diphtheria, and this readily distinguishes them from the truly diptheritic form of external otitis, in which the peculiar membrane is found in the auditory canal.

True diphtheria is usually caused by simple spreading of the inflammation from the nasopharynx to the ear. Otitis media occurs less often in the florid stage of diphtheria, more frequently after the acute manifestations and the fever have run their course. The healthy tympanic cavity, however, is germ free.

DIAGNOSIS

The diagnosis is not difficult when the picture of otitis media is fully developed, and there is diphtheritic inflammation of the external duct. The difficulty is greater when the inflammatory manifestations of the tympanic membrane are but slightly developed and the inflammatory process extends to the deeper parts. However, careful and repeated otoscopic examination, functional tests, and regular control of the temperature will lead to a correct diagnosis. The temperature should be continued in all cases of diphtheria as in scarlatina and measles, even after the fever has run its course. Should there be a fresh accession of temperature, the possibility of an inflammation of the middle ear should be considered, even in the absence of any particular otitic symptoms. Severe pain, over and in the ear, sensitiveness to pressure on the tragus and mastoid process, deafness, tinnitus, fever, and so forth, in all probability will be present.

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21. Scheppegrell, W.: New Orleans M. & S. J. **15**:711, 1912; Billington, C. E.: New York, William Wood & Company, 1889; Gruber: Lehr. d. Ohrenh.

Reporter	Years	Number of Cases	Age	Sex	Symptoms	Hearing	Left Drum Membrane	Right Drum Membrane	Both Drum Membranes	External Ear	Animal Inoculation	Microscopic Findings	Bacteriologic Findings	No Membrane	True Membrane	Pseudomembrane	Left Mastoidectomy	Right Mastoidectomy	Double Mastoidectomy	Radical Mastoidectomy	Chronic Otitis Media	Scarlet Fever	Measles	Throat and Larynx	Ulcerations	Treatment	Necropsy	Remarks
Wreden, R.: Ztschr. f. Ohrenh. **2**: 48	1868	7	6 wk. 40	6 M 1 —	7	4	2	3	1	5	0	0	0	2	0	5	0	0	0	0	0	3	0	3	1	3	2	
Wendt, H.: Arch. d. Heilk. **11**: 258	1870	2	(1) 2 (2) 4	(1) — (2) —	2	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	2	
Callan, P. A.: Med. Rec., New York	1875	1	26	F	1	1	0	0	1	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	Duration 4 weeks
Küpper: Arch. f. Ohrenh. **11**: 17....	1876	1	4	F	1	1	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	1	1	Caries lumbar vertebrae
Kraussold; Centralbl. f. Chir. **88**....	1877	1	22	F	1	1	0	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	Duration 3 weeks
Burckhardt-Merian, Klin. Vortr. **182**	1880	2	(1) 10 (2) 7	(1) F (2) M	2	2	0	0	2	2	0	2	1	0	0	2	0	0	0	0	0	0	0	0	0	2	0	No. 2 reported as primary case of ear No. 1 cervical adenitis
Bezold: Arch. f. Ohrenh. **14**: 66.....	1880	3	—	—	3	3	0	0	3	3	0	3	3	0	0	3	0	0	0	0	0	0	0	0	0	3	0	
Jacobson: Arch. f. Ohrenh. **19**: 29..	1882	2	(1) 5 (2) 9	(1) M (2) M	2	1	0	1	1	2	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	No. 1 reported as primary case of ear No. 2 discharge from ears for 8½ yrs.
Moos: Ztschr. f. Ohrenh. **12**: 1.....	1883	1	6	F	0	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	Granulomata middle ear
Burnett: The Ear, Philadelphia.....	1884	1	4	F	1	1	0	1	0	1	0	1	1	1	0	0	0	1	0	0	0	0	0	1	0	1	0	Right facial paralysis
Hirsch: Ztschr. f. Ohrenh. **19**: 101..	1889	2	(1) 7 (2) 1¾	(1) F (2) F	0	1	0	0	2	2	0	2	2	0	0	2	0	1	0	0	0	0	2	0	0	0	2	No. 1 thrombosis sinus
Blau: Arch. f. Ohrenh. **27**: 152.....	1889	1	15	F	1	1	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	
Siebenmann: Ztschr. f. Ohrenh. **20**: 1	1890	1	7½	F	1	1	0	0	1	1	0	1	1	0	0	1	0	0	0	0	0	1	0	0	0	1	1	Septicemia
Councilman: M. Sc. **11**: (Series 106)	1893	3	—	—	0	0	0	0	0	0	3	3	3	0	0	3	0	0	0	0	0	0	0	0	0	0	0	
Wright: Boston M. & S. J. **131**....	1894	2	(1) 1 (2) 10 wk.	(1) F (2) F	2	2	0	0	2	2	2	2	2	1	0	0	0	1	0	0	0	0	0	1	1	2	2	(1) Meningitis (2) Diphtheria vaccination pustule
Rimini: Berl. klin. Wchnschr. **33**: 609	1896	1	3½	—	1	1	0	0	1	1	0	1	1	1	0	0	0	0	0	0	0	1	0	1	0	1	1	
Lommel: Arch. Otol. **26**.....	1896	25	—	—	25	25	0	0	0	0	0	9	9	8	0	1	0	0	0	0	0	0	0	1	0	25	25	1. Pneumonia
Podack: Arch. f. klin. Med. **56**: 34	1896	3	—	—	0	1	0	1	2	1	2	3	3	1	2	0	0	0	0	0	0	1	3	1	0	0	2	No. 1 tracheotomy No. 2 pneumonia
Stephens and Parfitt: J. Path. & Bacteriol	1897	1	13 mo.	M	0	1	0	0	1	0	1	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	1	Meningitis
Krepuska: Pest. med.-chir. Presse. **33**: 609	1897	1	30	M	1	1	1	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	Reported as primary case of ear; duration 2 months

Lewin: Arch. f. Ohrenh. **53**: 1.....	1901	1	14 mo.	M	1	1	0	0	1	1	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	1	1	Pneumonia
Bellows: N. Am. J. Hom. **17**: 51....	1902	2	(1)27 (2) 5	(1) F (2) F	2	2	0	1	0	2	0	2	2	2	0	0	0	0	0	0	0	0	0	2	0	2	0	
Kobrak: Arch. f. Ohrenh. **62**: 21....	1904	3	(1)— (2) 2 (3) 2½	(1)— (2)M (3)M	2	3	0	1	2	3	1	3	3	2	0	1	0	0	0	0	0	2	0	1	0	1	0	(1) Death; no necropsy (2) Reported as primary case of ear
Daae: Ztschr. f. Ohrenh. **52**: 249....	1906	1	11	M	1	1	0	1	0	1	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	Embolic pneumonia; reported as primary case of ear
Cozzolino: Pediatria **15**: 908.....	1907	1	2½	M	1	1	1	0	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	Reported as primary case of ear
Connal: Brit. M. J. **1**: 139.....	1907	1	12	M	1	1	1	0	0	1	0	1	1	0	0	1	1	0	0	1	1	0	0	0	0	1	0	
Stein: Ztschr. f. Ohrenh. **56**: 325....	1908	3	(1)10 (2)41 (3)55	(1)M (2)M (3)M	3	3	2	0	0	3	0	3	3	0	0	3	0	0	0	0	0	0	0	0	0	3	0	Reported as primary cases; duration of cases 1 month
Forbes: J. Path. & Bacteriol. **8**.....	1903	32	—	—	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	Bacteriological report
Mekler: Arch. Int. de Laryngol. **31**: 876	1911	1	21	F	1	1	1	0	0	1	0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	
Benesi: Wien. klin. Wchnschr. **27**: 1385	1912	1	19	F	1	1	1	0	0	1	0	1	1	1	0	0	1	0	0	1	0	0	0	0	0	1	0	Duration 6 weeks
Haskin: Ann. Otol., Rhinol. & Laryngol. **23**: 450	1914	1	51	M	1	1	1	0	0	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	Reported as primary case
Thompson: Laryngoscope 219.....	1914	12	—	—	12	12	0	6	2	0	1	11	11	4	0	8	0	6	0	0	0	0	0	0	0	12	0	Six operated cases with ear not stated
Vinsonhaler: South. M. J. **9**: 839....	1916	2	—	—	2	2	0	1	1	2	0	2	2	1	0	1	0	0	1	0	0	0	0	2	0	2	0	Infection of antrum and frontal in 1 case
Bane: Laryngoscope 626.....	1917	1	72	M	1	1	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	Reported as primary case in ear
Sterling: Berl. klin. Wchnschr. **54**: 503	1917	1	8	F	1	1	0	0	1	1	0	1	1	1	0	0	1	0	0	0	0	1	0	0	0	1	1	Meningitis Diphtheria carrier
Von Szász: Wien. klin. Wchnschr. **27**: 756	1918	50	—	—	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Shoji: J. Japan Otol., Rhinol. & Laryngol. **24**: 291	1918	1	—	—	1	0	0	0	0	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	Diphtheria bacilli in urine; reported as primary case in ear
Pugnat: Rev. de Laryngol. **40**: 377	1919	2	(1)48 (2) 2	(1)F (2)—	2	2	1	1	0	2	1	2	2	2	0	0	1	0	0	0	0	0	0	0	0	2	0	(1) Reported as primary case in ear (2) Left mastoidectomy
Robenhaven: Ugesk. f. Læger.....	1919	1	4½	F	1	1	0	0	1	1	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	1	0	Left facial paralysis; diphtheria carrier
Kahn: Laryngoscope **32**: 729.....	1922	1	20	M	1	1	0	1	0	1	0	1	1	0	0	1	0	0	0	0	0	0	0	1	0	1	0	Mastoiditis right (no operation)
Blanchard: J. A. M. A. **78**: 1458....	1922	1	22	M	1	1	0	0	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	Coryza
Mellinger: Calif. State J. Med. (Apr 1)	1923	11	(1)3 (10)—	(1)— (10)—	(1)	(1)			(1)	(1)	(1)	(1)	(1)	(1)												(1)		(1) Reported as primary case of ear
Webber: Ann. Otol., Rhinol. & Laryngol. (Dec.)	1923	2	(1)52 (2) 3	(1)M (2)—	1	1	0	0	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	(1) Erysipelas
Rohden: Ztschr. f. Hals-Nasen u. Ohrenh. **4**: 284	1923	1	17 mo.	—	2	2	0	1	1	2	0	2	2	2	0	0	0	1	1	0	0	0	0	1	0	2	0	(2) Reported as primary case of ear
Total.....44	1868 to 1924	194	6 wk. to 72	M=24 F=19 —=150	1	1	0	0	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	1	0	1	1	Tracheotomy; pneumonia
					91	88	12	22	30	56	14	72	70	38	4	41	4	10	4	2	2	11	6	20	2	86	42	

Bacterial examination will settle whether the otitis has been caused by the Klebs-Loeffler bacillus or by others. Streptococci are most frequently found in the postdiphtheritic stages. This examination is best carried out with the secretion obtained at the time of incising the drum membrane. The only way of determining the virulency of the culture is by inoculation of the rabbit or guinea-pig.

TREATMENT

Injection of large enough doses of antitoxin is the principal treatment, aside from the instillation of antitoxin on to the membrane in the external ear. Some writers advocate the use of lime water in the external canal when a membrane is present. Although it is possible that involvement of the canal might cause stenosis, suitable use of alcohol wicks will control this condition. The prognosis is not unfavorable, provided the local and general treatment have been instituted in time. Ever since the introduction of antitoxin, the frequency of suppurative otitis media seems to have diminished, and the course of the condition to have become milder. Various epidemics, however, vary distinctly as to their virulency and areas of the body attacked. As compared with measles and scarlet fever, the aural complications in diphtheria are both infrequent and mild. There is greater danger of extensive destruction of the membrana tympani than of rapid and serious involvement of the mastoid cells. It may occur in communities where there is a scarlet fever epidemic, with no diphtheritic epidemic present at the time.

The reports of the two cases of diphtheria of the middle ear which have come under my personal observation are as follows:

CASE 1.—E. C., a girl, aged 18 months, had been under treatment for several weeks with an indefinite intestinal disorder, causing the ordinary fermentive diarrhea. As the temperature, apparent pain, intermittent crying and marked restlessness were not in accord with the fermentation, I was asked to see her ears. In the left ear the external canal was red, and the canal lumen was narrowed by swelling. On closer inspection, a pulsating grayish mass, which at first looked like pus, was observed at the drum. Wiping it away, I noticed that it was membranous and it bled at the slightest touch at the edge. When wiped the child cried actively from pain. The drum membrane had ruptured and through this torn aperture appeared the membrane and the pus exudate. A culture from the latter showed Klebs-Loeffler bacilli, which subsequently proved fatal to a guinea-pig. The right drum membrane was slightly injected but not bulging. The nose was quite normal, as was the pharynx, except that the left tonsil was enlarged as was the cervical gland on the same side. Repeated cultures from the nose and throat remained negative. The mother mentioned the fact that the gland had been enlarged slightly for nearly a year. The chest, heart and reflexes were negative. The urine showed a slight trace of albumin, but otherwise was not significant. The leukocyte count was 18,000, the erythrocytes were slightly below normal. The child was isolated and received 3,000 units of antitoxin. The temperature at the time of examination was 102.4 F., the next day it dropped to 99.8 F., but on the third day again rose to 103 F. I examined the right ear, and although the redness

had increased there was the same amount of bulging. As the mastoid was slightly painful to the touch, I incised the drum. The exudate was serous, but the culture showed it to be diphtheritic. Again 3,000 units were given to the baby; the temperature dropped during the day and did not again rise. The membrane in the left ear canal rapidly disappeared, but cultures from the ear remained positive for nine days. The right drum was easily healed, but the left drum became dry in two months' time, leaving an open perforation. A subsequent blood examination (four days after the first specimen), showed normal leukocytes and erythrocytes, while the differential count showed neutrophils, 75 per cent.; lymphocytes, 22 per cent.; eosinophils, 3 per cent. The right ear was treated locally with sterile wicks in the canal, and gauze on the outside. The discharge remained serous. In the left ear, hot boric irrigations were followed by wiping the canal; during the first two days three drops of antitoxin were placed in the canal.

CASE 2.—L., aged 9 months. The family physician asked me to examine the ears, thinking that they were probably the cause of a febrile temperature (104 F.). The throat was red, with a slight amount of serous discharge from the nostrils. Both drum membranes were red and bulging and the mastoid regions were red and tender. The chest, abdomen, heart, reflexes and extremities were normal. Free incision of both drums was followed at once by pus discharge. Both ears were irrigated every two hours, the head was elevated, and argyrol was dropped into each nostril every four hours. The temperature did not subside, and the child seemed more stuporous, not eating, at times rather hard to arouse, and at frequent intervals putting the hands to the ears. On a second visit I found extruding from both ear canals a peculiar thick nonmembranous mass, pulsating through the incised drums. Both mastoid regions were tender and there was a slight periosteal thickening. Cultures taken from the ear discharges proved to be positive Klebs-Loeffler, and were lethal to a guinea-pig in seventy-two hours. The persistent nasal discharge was also cultured, but showed pneumococci only. The throat culture was reported suspicious, but at no time could anything be seen except a glazed, red throat. This latter culture was injected into a guinea-pig without results. There was no enlargement of the cervical glands during the illness. Five thousand units of antitoxin were given, and almost at once a difference in both ears was noticed. At the end of three weeks both ears were dry, the cultures being negative after the fifth day. The leukocyte count at first was 21,000, with normal erythrocytes. The urine was normal at each examination; the temperature became normal on the fourth day, while the apparent stupor vanished in five hours, following the injection of antitoxin. In all, 10,000 units of antitoxin were injected.

CONCLUSIONS

1. Acute inflammation in diphtheria is apt to be mono, chronic inflammation, polybacterial.

2. An ordinary inflammation of the middle ear, connoting serious general infection, does not imply serious ear disturbance.

3. Otitic diphtheria apparently is spread through the blood rather than directly from the pharyngeal space.

4. Purulence may be the only clinical evidence of diphtheria of the middle ear.

5. The term nonvirulent should be used in place of pseudovirulent, as all true Klebs-Loeffler bacilli are not necessarily virulent toward guinea-pigs.

6. Routine bacteriologic examinations should be made of all ear discharges. This applies equally to mastoid operations.

7. Diphtheria is less destructive to the middle ear than is scarlet fever or measles.

8. Diphtheria of the ear does not represent a genuine disease, but occurs as one of the symptoms of a general infection.

PHYSIOLOGY OF THE LABYRINTH

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Investigations in regard to the function of the otic labryinth have been carried on in many countries during the last decade and, as a result, our knowledge of the structures that it contains has made decided forward progress. This progress has given the term neuro-otology a significant meaning, and justifies the hope that the future will show an even closer association of otology and neurology. After all, otology is but a small though important subdivision of neurology. In this progress no investigations have been so illuminating, so pregnant of results as those which have come from the sustained activities of Professor Magnus[1] and his co-workers in Utrecht. We therefore welcome the recent published summary of their work on the Function of the Semicircular Canals and the Otolith Organs.

Such a summary is especially welcome since the original papers are scattered through many periodicals as far back as 1909. Its publication may be said to indicate the close of the first stage of their investigations, and there now remains the application of their findings to the human subject and to clinical diagnosis. Their work on mammals has thrown a flood of light on many obscure problems apart from the labyrinth; it has experimentally proved or placed on a surer and broader basis many theories advanced by previous workers on more or less substantial ground. They have been able to show more definitely the connection of the vestibular nerve with various centers in the brain stem, and the interaction that takes place to yield the harmony so essential to equilibrium.

They found in the labyrinth of the mammal a peripheral organ not too inaccessible, which offered a basis from which to study and analyze the reflex processes by which the animal alters and maintains its posture in standing and in progression, and how automatically it adjusts itself correctly to the world in which it lives. "The body's automatism ensures that the mind looking, so to say, out from the body finds the world right side up and that relation is shown to be maintained by processes as non-mental as is digestive secretion of the bile" (Sherrington). They traced the seat and nature of the stimuli by which the reflexes are induced, the approximate location in the central nervous system where coordination of the various reflexes concerned can come

1. Magnus and de Kleyn: Experimentelle Physiologie des Vestibular Apparates bei Saugetieren mit Ausschluss des Menschen, Handb. d. Neurol. d. Ohres **1**:465-532, 1923.

together to produce the necessary effective response. The fine grade of mutual interaction resulting from this coordination gives one a realization of the complexities of the muscular activities called into play in the maintenance of equilibrium, in which interplay the labyrinth has an important rôle.

The subject is dealt with in three main sections:

1. Movements of the neck, eyes and extremities produced reflexly from the semicircular canals by angular acceleration. Included in this are changes produced during progressive movement.

2. Reflex movements produced from the vestibule by thermic and galvanic stimulation.

3. Reflexes from the otolith apparatus resulting from a change of the position of the animal. This section discusses the tonic labyrinth reflexes on the body musculature, on position reflexes and on compensatory eye positions.

Introducing each section is a survey of the result of previous workers, bearing on and leading up to a concise account of their own results. These include a description and analysis of the labyrinth reflexes seen in the normal animal and the modifications of these reflexes by various experimental lesions. While the labyrinth is the main theme of this article, yet an appropriate account is given of their investigations on the neck reflexes and of other reflexes which modify vestibular influences.

REACTIONS BY ANGULAR ACCELERATION

In the first section dealing with reactions from the semicircular canals by angular acceleration, the reactions on the neck, on the eyes and on the trunk and limb musculature are dealt with in separate subsections. They make a sharp distinction between the function of the canals and the function of the otolith apparatus, ascribing to the canals all reactions to rotations, and to the otolith apparatus all reactions depending on definite positions and probably rectilinear movements. To ascertain which reflexes come from the canals and which from the otolith apparatus their findings are primarily based on the experiment first done by Witmaack, who showed that if a guinea-pig be centrifuged at high speed, the otolith membranes would be placed completely out of action while the canals remained normally responsive.

REFLEXES BY CALORIC AND GALVANIC STIMULATION

The second section treats of reflexes produced by caloric and galvanic stimulation. Various hypotheses in regard to the origin are discussed, including the hypothesis of Borries that it may originate in the maculae. This they decline to accept, giving among other reasons the finding that

cold water nystagmus is unchanged by removal of the otolith membrane. In discussing nystagmus, it is pointed out that while there is general agreement that the slow phase is a reflex over the vestibular nerve to the eye nuclei, the genesis of the quick phase and its significance is still problematical. They reject Bartels' hypothesis that the quick phase originates from a stimulation of the proprioceptive nerves of the eye muscles, arising from the action on the muscles of the slow phase and content themselves by saying that the quick phase is central. There is, unfortunately, no reference to work done in this country on this subject. The question of the origin and pathway of the quick phase is one of clinical importance, for it is known that the quick phase of eye oscillations which normally arises from labyrinthine stimulation fails to appear or is modified in many intracranial conditions. Most of the experiments we hear of done in Europe have been carried out on rabbits and guinea-pigs, the low cranial development of which animals are not likely to lead to conclusions in this subject. Further reference is made to this in the review of the work of de Kleyn and Barenne on a later page.

REFLEX NERVE MECHANISM

The reflex nerve mechanism, by means of which tone is regulated or modified, is dealt with in the third section. It is now many years since they showed that it is possible to modify the distribution of extensor tonus to the musculature of the body of decerebrate animals (the general position of its individual parts; its attitude) by particular posture of the head conforming to a definite set of rules. In the decerebrate animal, in which the free action of the peripheral reflexes can be studied independent of cerebral factors, they found that whenever the head is made to assume a particular position, the rest of the body takes a corresponding position in keeping with the head posture. This interesting relationship was shown to be the result of two different continuously acting groups of reflexes, tonic reflexes from the labyrinth and tonic reflexes from the neck. Tonic reflexes from the labyrinth are produced by the particular position of the head in space, in relation to the horizontal. Tonic neck reflexes are produced through the head occupying a given position in relation to the body. So long as the head maintains the position in space, or the head and body preserve their relative position to each other, both these reflexes are permanent and remain unmodified.

If one is desirous of examining the tonic labyrinth reflexes, the neck reflex must be excluded. This is done either by dissecting the cervical dorsal roots or by preventing all movements of the head relative to the trunk, for instance, by a firm plaster cast bandage. If decerebrate animals deprived of neck reflexes are brought into different positions in space, there is one position of the head (namely, the animal on its

back with the snout slightly raised) in which the extensor tonus of all four limbs is at its maximum. In the opposite position of the head, namely, belly down, the head normal with slightly lowered snout, that is, rotation of 180 degrees around a transverse axis, the extensor muscles of the limbs show a minimum rigidity of decerebration. In all other positions of the head in space during the transverse rotation, the degree of tonus of the extensor muscles lies somewhere between these two extremes. With the animal on its side rotation around a longitudinal axis (parallel to spinal column) to a position with the back down gives increasing rigidity, to a position belly down gives decreasing extensor rigidity. With the animal on its side, rotation around antero-posterior axis gives increased tonicity if the head is raised, decreased if the head is lowered. With each varying extensor rigidity of limbs, a definite change in attitude occurs. The extension of the muscle is varying and is more striking the more the leg was previously bent, so that a weight attached to the foot by a thread over a pully may be raised by this extension. While the flexor muscles are not concerned in the rigidity they participate, for when the head is put in a position with which the least extensor rigidity is associated there is an active bending of the limb. All the foregoing reactions are due to the position of the head in space and can be elicited by movement of the head only. Rotation in a horizontal plane is ineffective and progressive movements are without influence.

These reflexes start from the otoliths of the utricular maculae and are at their maximum when the otolith hangs from the macula. The utricular macula is in the plane of the horizontal canal, the saccular macula is in the saggital plane. Each macula stands in functional relation with the extensor muscles of the limbs on both sides of the body. There are also tonic reflexes from the utricles on the trunk muscles, particularly those of the neck, which follow the same laws, with this difference that the communication between each macula and these groups of muscles is homolateral. It is this homolateral action of the neck muscles which explains the well-known attitude of the head (Grund-drehung) which the animal assumes after labyrinthine destruction but which is not observed in man. The centers for the tonic labyrinth reflexes on the muscles of the body lie in the medulla oblongata caudad from the entrance plane of the nervus octavus.

To examine the tonic neck reflexes it is necessary to exclude the labyrinth reflexes, which can be done by extirpation of the labyrinth on both sides. Then one finds that after modification of the relative positions of the head to the body, almost always one pair of extremities reacts in the opposite direction from the other pair. Bending the head ventrally, for instance, causes atony of the front limbs and stretching

of the hind limbs; lifting the head causes stretching of the fore legs and atony of the hind legs; turning and bending of the head leads to stretching of the extremities on one side of the body and to atony on the other side.

Tonic labyrinthine and tonic neck reflexes persist so long as the head position is preserved. They are positional reflexes. The flexor reflexes, so far as they are active, are also positional but react in the opposite direction. When both labyrinthine and tonic neck reflexes are preserved, they combine differently according to the initial positions of the body as the head changes its position.

If the transverse section through the brain stem be made in front of the foremost part of the mesencephalon in such thalamus or midbrain animals,[2] one obtains an entirely different picture from that seen in decerebrate animals. The rigidity disappears, and in its stead there appears a more regular distribution of tone among the extensors and flexors of the body. Position and posture are exactly like those of animals with intact cerebrum; the extensor muscles possess just as much tone and the flexors distinctly show the presence of tone. In addition to the absence of the extensor rigidity of decerebrate animals and the presence of a normal tone distribution, thalamus animals show a further material difference from the decerebrate animal. The latter, when it falls, remains down, whereas the "midbrain" animal resumes at once the normal position, due to reflex action. Magnus names these reflexes which enable an animal to resume the normal at all times through reflex action and to remain in that position, stellreflexe.[3]

The analysis of righting reflexes has shown that the labyrinths participate herein as receptors (as is the case with attitude reflexes), but they are by no means the only peripheral organs from which these reflexes are released. If a thalamus animal is held free in air, avoiding strictly all contact with a support, in all the different postures of the body in space the head will be brought back to normal (be righted) by appropriate movements of the neck and maintained there, whether the animal's pelvis be maintained on its side, back or any vertical position. When, however, both labyrinths of such an animal are extirpated, this power vanishes and the head is held in the same position in space as the remainder of the body. Thus, when the body is placed on its side, the head is also kept on its side, when on its back, also on its back, and so forth. In short, the head has lost its faculty for orientation in space. These righting reflexes from the labyrinth on the head are released by

2. The name signifies the highest preserved brain position.

3. The word "Stellreflexe" is difficult to translate; Walshe has suggested "righting reflex" and this term has been accepted by Magnus (Physiological Abstracts, 1924, p. 2148).

the maculae of the saccular otoliths, though possibly the utricular otoliths also participate.

The other chief factor controlling the righting reflex of the head is afferent impulses from tactile end-organs all over the body. If a labyrinthless thalamus rabbit is held free in air, so that its head loses the faculty of orientation, and subsequently is placed, say, on its side on a table, immediately the body comes in contact with the support, a reflex is released, by which the head is turned to normal in spite of the missing labyrinths. The effective stimulus is the asymmetrical excitation of organs pertaining to the sense of touch by the contact with the support. This can be proved by neutralizing the asymmetrical pressure, for instance, by means of a weighted board pressed on the side which is uppermost. Then the head goes back at once to the apathetic position. As soon as the pressure is removed, however, the head turns once more to normal. In the lower mammals the righting reflex comes from the saccules, probably also the utricles, and from cutaneous afferent impulses. In the higher mammals, dog, cat and monkey, additional impulses come from the eyes. Thus, a monkey deprived of the labyrinths, held free in the air, is unable to bring its head into normal position with the eyes bandaged but can do so if sight be present.

The maximum of otolith excitation occurs when the otolith hangs; the minimum when it presses. While the inherent stimulation is in the macula, the epithelium of the macula without any action of or connection with otolithic membranes is able to produce its own excitation. The function of the otolith is to increase or diminish the amount of excitation produced in the epithelial cells of the macula, the otolith modifies the strength of this reaction, not by shifting its position but by pressing or pulling on the epithelium.

COMPENSATORY REFLEXES

In the extrinsic muscles of the eyes we have special examples of compensatory reflexes. Here each movement of the head or neck produces a compensatory movement of the eyes to preserve their position in space, and these are held in this position as long as the altered position of the head remains. Their functional activity depends on a constant relation to the horizontal. No matter how the head shifts, this adjustment of the eyes to the horizontal must be insured, and must be retained as long as the attitude of the head is in this posture. Thus, in movement of the head upward the eyes roll down and within limits the fixation will persist, the fixation being determined by the desire or ability to focus on a particular object. Here, in keeping with the general action of proprioceptors, the labyrinths act to adjust and maintain the posture of the eyes in varying movements of the body.

Van der Hoeve and de Kleyn studied the tonic labyrinth reflexes in the eyes of rabbits, and found that each movement of the head in space gives a particular "roll" of the eyes, rotatory or vertical or a combination of these, and that each position of the head in space necessitates a definite position of the eyes, and that this modified position persists as long as the head is kept in the modified position. One labyrinth influences the eyeball rotations of both eyes, but chiefly the muscles of the opposite side. After the labyrinths on both sides have been extirpated, all such tonic reflexes of the eyes from modifications of the head in space cease. Lateral horizontal (linear) movement in space produced no modification of eyes corresponding to that before mentioned. They believe that these compensatory eye positions are brought about by reflexes from saccular otolith movements and this action is greatest when the otoliths are hanging from the maculae. These reflexes are lasting, and are to be distinguished from the deviations which come from the semicircular canals by rotation and caloric which are transitory. The investigations of these authors showed that the rectus externus and internus muscles are not influenced by the otoliths but are by the semicircular canals. This agrees with Maxwell,[4] who found that the otolith organ (macula) responds to rotation in all planes except the horizontal, and that the horizontal canals are necessary to reaction to movement in the horizontal plane.

COMMENT

This brief account of the work done in Utrecht will, it is hoped, stimulate sufficient interest to produce a translation of this work into English and so make it easily accessible. It would be hazardous at present to carry their findings too hastily over into clinical neurology, since many readjustments have occurred in the brain of the higher mammals and especially in man. It will have been noted that modifications of labyrinthine reflexes occur as a part of phylogenetic development. The findings in the monkey differ in some respect from those in the guinea-pig and rabbit, and in man from the monkey. To take but one example, deviation of the head following labyrinthine destruction does not occur in man. Such modifications were to be expected from the changes which cerebral development has produced from shifting forward of centers and from more complex association paths which occur in the higher mammals and especially in man. A realization of these modifications from phylogenetic development will avoid too hasty deductions, for instance, the transference from animal to man of corresponding cerebral localization of function areas. But the fundamental reactions

4. Maxwell, S. S.: Labyrinth and Equilibrium, J. Gen. Physiol. **2**:123 (Nov.) 1919.

remain unaffected; the vestibule is a peripheral organ related to the maintenance of the normal and the correction of the abnormal position of the head in space.

In a recent paper, Dusser de Barenne and de Kleyn [5] have discussed the vestibular reflexes after removal of a cerebral hemisphere in rabbits. They chose animals in which the equal caloric excitability was present and variations in rotation nystagmus were small. They reached the following conclusions: After removal of one cerebral hemisphere (namely, the left) they found that the after nystagmus after right rotation, the cold caloric stimulation of the right ear, the warm caloric stimulation of the left ear, that is, a nystagmus with rapid component to the left and slow to right, is stronger than the nystagmus with the quick component to right and slow to left. In this respect they confirm the findings of Wilson and Pike,[6] who found that lesions of the cerebral hemisphere on the side of the slow deviation of the eyes abolish or reduce the quick component. This is a subject of clinical importance, for it has been found in man that lesions at the region of the mesencephalon and even above have produced the dropping out or modification of the quick phase.

Magnus and de Kleyn [7] have carried out a series of investigations in guinea-pigs by paralyzing the labyrinth with injections of cocain into the middle ear in normal animals and animals in which one labyrinth has been destroyed. They were able to confirm their previous findings that the function of the otolithic membrane consisted in altering the intensity of the stimulation of the sensory epithelium of the macula which is in a constant state of stimulation. They found that in the normal animal following the injection, the saccule was the first part to be affected (shown by vertical eye deviation without nystagmus and absence of labyrinth righting reflex when the animal was placed on the injected side), then followed paralysis of the utricle (shown by the Grund-drehung) and last the semicircular canals were paralyzed when nystagmus appeared. In the animal in which the labyrinth has been removed, the posture and the nystagmus present will in a similar sequence disappear. They believe that their findings show that the sensory epithelium of the cristae probably possesses the property of

5. Dusser de Barenne, J. G., and de Kleyn: Ueber vestibulaire Augenreflexe, Arch. f. Ophth. **3**:374-392, 1923.

6. Wilson, J. G., and Pike, F. H.: The Mechanism of Labyrinthine Nystagmus and Its Modifications by Lesions in the Cerebellum and Cerebrum. Seventeenth International Congress of Medicine, London, 1913, p. 569; ibid. Arch. Int. Med. **15**:8 (Jan.) 1915.

7. Magnus and de Kleyn: A Contribution Concerning the Function of the Vestibular Apparatus, Koninklijke Akademie van Wetenschappen Te Amsterdam; Proceedings XXVII, Dec. 1923, pp. 201-216.

producing continual stimuli, and that the strength of these stimuli is varied by mechanical influences reaching the cristae by accelerations of movements of the head.

Maxwell [8] recently published a paper dealing with the effect of habituation on the rotation nystagmus. It had previously been shown that in rabbits the amount of after nystagmus following rotation decreases with habituation. Maxwell found that in the course of a few days or a few weeks at most, the after nystagmus became negligible in amount or entirely disappeared, and it was noticed that when the after nystagmus had disappeared the rotation nystagmus appeared normal. His results show that the amount or duration of after nystagmus following rotation is no reliable indication of the functional activity of the equilibrial apparatus.

Maxwell,[9] in a later paper, showed that the response to rotation in the light differs from that in the dark, and hence that retinal modification of labyrinthine excitation does occur in the rabbit; second, that the response to repeated rotation in the light differs from that in the dark. A normal pigeon may show, during rotation, compensatory position or nystagmus, both of head and eyes. If, however, the bird is surrounded by a gray cylinder, little or no nystagmus appears during the rotation but a considerable after effect appears. If both labyrinths of the pigeon are extirpated, nystagmus is seen during rotation, but no after effect is observed. When such a pigeon is surrounded by a gray cylinder, there is neither rotation nystagmus nor after nystagmus. In the light the stimulus consists of the excitations both from the labyrinth and the retina, while in the dark the stimulus is entirely due to the excitations arising from the labyrinth.

Dodge [10] has published an article on the important subject of the threshold of rotation.

> The practical bearing of the threshold of rotation relates to the orientation of the flier and to the relative importance, dependability, and possible correction of subjective data for the piloting of airplanes and gliders. There are well-authenticated accounts of aviators making a complete loop in the clouds without knowing it, of emerging from the clouds after making a half loop, flying upside down. Similarly, travellers lost in the desert or in snow fields are commonly reported to circle back to their own tracks. To keep a straight course on land, at sea, or in the air, without some objective point of reference is impossible for any considerable length of time. If this is true, it is of practical use to ask: What is the minimum rotation that the

8. Maxwell, S. S.: The Effect of Habituation on the Rotation Nystagmus as Compared with the After Nystagmus in the Rabbit, Am. J. Physiol. **68**:125-126, 1924.

9. Maxwell, S. S., and Pilz, George F.: On the Relation of Labyrinthine and Retinal Excitations in the Rabbit, Am. J. Physiol. **70**:118 (Sept. 1) 1924.

10. Dodge, Raymond: The Threshold of Rotation, J. Exper. Psychol. **6**:107-136, 1923.

vestibular mechanism may be relied on to detect; under what circumstances does the vestibular mechanism function as an adequate control of locomotion; and how far may it be trained?

His conclusions are:

1. Vestibular data from rotations of less than 2 degrees per second are unreliable. With double that velocity judgments are often false.

2. Taking a previous study of the results of protracted rotation into consideration, the vestibular problem in flying would seem to be:

1. Under what conditions in the air are vestibular data sufficiently accurate to be useful?

2. How may vestibular illusions of rotation be corrected or compensated?

3. How may we develop, coordinate and systematize data from the various parts of the receptor field into the most effective control of flying under varying circumstances? These circumstances should include the temporary loss of visual data at night or in fog, as well as the illusions of vestibular and of centrifugal origin.

News and Comment

SECTION MEETINGS OF THE AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, 1925

MIDDLE SECTION: Meets at Lafayette, Ind., Feb. 23, 1925. Chairman, Dr. F. Keiper, Indianapolis.

MID-WESTERN SECTION: Meets at Colorado Springs, Colo., Feb. 14, 1925. Chairman, Dr. D. A. Vanderhoof, Exchange National Bank Bldg., Colorado Springs.

WESTERN SECTION: Meets at San Francisco, Calif., Feb. 27, 1925. Chairman, Dr. E. C. Sewell, 3315 Pacific Avenue, San Francisco.

LOCAL SOCIETY MEETINGS

PHILADELPHIA: Section on Otology and Laryngology of the College of Physicians of Philadelphia, meets third Wednesday of the month from October to June, at 8:30 p. m., at the College of Physicians. Chairman, Dr. Fielding O. Lewis; Secretary, Dr. James A. Babbitt, 2117 Chestnut Street.

CLEVELAND: Ophthalmological and Otolaryngological Section of Cleveland Academy of Medicine, meets fourth Friday of each month at the Winton Hotel. Chairman, Dr. E. W. Garrett; Secretary, Dr. M. Paul Motto, Rose Bldg.

CHICAGO: Chicago Laryngological and Otological Society, meets first Monday of the month from October to May at the Crystal Room, Great Northern Hotel. Chairman, Dr. E. H. Norcross; Secretary, Dr. A. A. Hayden, 25 East Washington St.

NATIONAL SOCIETY MEETINGS

The American Otological Society will hold its annual meeting at Hotel Raleigh, Washington, D. C., Monday and Tuesday, May 4 and 5, 1925. Dr. Eugene A. Crockett, Boston, President; Dr. T. J. Harris, 104 East 40th St., New York, Secretary.

The American Laryngological, Rhinological and Otological Society will hold its annual meeting at Atlantic City, N. J., on May 22 to 25, 1925, inclusive. Dr. W. H. Haskin, New York, President; Dr. R. L. Loughran, 145 West 58th St., New York, Secretary.

TRANSACTIONS OF AMERICAN OTOLOGICAL SOCIETY

Any one desiring to complete his files of Transactions of the American Otological Society may do so on application to the secretary, Thomas J. Harris, M.D., 104 East 40th Street, New York City.

Abstracts from Current Literature

Ear

AURAL SURGERY AT A FEVER HOSPITAL. F. BRAYSHAW GILHESPY, J. Laryngol. & Otol. **39**:605 (Nov.) 1924.

The author stressed the arrangement of the ear cases in the hospital. He discussed the time of onset of otorrhea, and advised the removal of the focus of infection in the nose and throat, especially the adenoid, during the fourth week of scarlet fever. In persistent otorrhea, it is important to examine the sinuses. Diphtheria antitoxin is given before tonsillectomy. The removal of the tonsils and adenoids lessens the duration of otorrhea by one-half; it also cures some persistent diphtheria carriers. There are some ingenious charts showing the progress of otorrhea from day to day. By the follow-up system, children are watched in the schools, and any showing recurrence of discharge are asked to report back to the ear clinic.

The incidence of measles during the first five years of life, would suggest that timely treatment of the adenoids might lessen subsequent disease of the ear.

OTITIS MEDIA IN MEASLES. W. T. GARDINER, J. Laryngol. & Otol. **39**:614 (Nov.) 1924.

The only cases of measles treated in an infectious disease hospital, are from the very poor sections when serious complications have developed, or the cases arising in boarding schools, etc. The statistics, therefore, are not as valuable as those of scarlet fever or diphtheria.

In the Edinburgh City Hospital for infectious diseases, there were 1,331 cases of measles in four years, and in this number there were 181 cases of otitis media, or 13.5 per cent. Otitis media is comparatively rare in the measles occurring in private practice. Ninety-six per cent. of these hospital cases were under 2 years of age, and as bronchopneumonia is so common, the otitis is overshadowed. If the child survives, one is disinclined to risk operative interference, so the patient is sent home with the ear discharging, and the parents are advised to return with the child to the outpatient clinic.

Whether adenoids are present or not, does not affect the incidence of otitis media and mastoid complications, but the condition in patients without adenoid tissue was always milder. If an adenoid was present in persistent cases of otitis media, its removal resulted in a rapid cessation of discharge. The onset of otitis media was either in the first week of the disease, with pain, or late in the sixth week, when discharge was the first symptom. In the late cases, an adenoid was always found.

Of 181 cases of otitis media, there were five which developed mastoiditis, not differing from the ordinary course of a streptococcus infection. In two cases of measles complicated with scarlet fever, the mastoiditis was marked by an excessive destruction of bone, and the recovery was slow and tedious.

THE EXPERIMENTAL BASIS FOR THEORIES ON VESTIBULAR FUNCTION. R. MAGNUS, J. Laryngol. & Otol. **39**:677 (Dec.) 1924.

There is a brief review of the early theories on the relationship between the labyrinth and muscle tonus.

The author groups the reflexes from the labyrinth (absent after labyrinth extirpation) under two headings:

1. Reflexes responding to movements (accelerations), transient and excited by semicircular canal stimulation. (*a*) Rotary reactions on the head, eyes, limbs, and trunk. (*b*) Progression reactions.

2. Reflexes; resulting from position, maintained and depending on the otolithic apparatus. (*a*) Tonic labyrinthine reflexes on the body musculature. (*b*) Labyrinthine righting reflexes; asymmetrical reflex from the saccule, and the symmetrical reflex from the utricle. (*c*) Compensatory eye positions; verticle from the saccule, and the origin of the rotary reflex is unknown.

In centrifugalized guinea-pigs, where all four otolithic membranes have been displaced, the reflexes resulting from position are absent, but the animal will still respond to changes of acceleration. Hence the reflexes of the first group, including the progression reactions, are elicited in the semicircular canals. The second group are otolithic in origin (it is still possible that the otoliths may also be stimulated by acceleration).

To determine the state of excitation of the macular sensory epithelium, a guinea-pig is used about eight days after centrifugalization. Cocain is injected into one middle ear. There is a turning of the neck, and there are vertical eye deviations, which must be due to stimuli from the opposite unanesthetized side. This would seem to show constant excitation of the macular epithelium, and that the otolithic membrane merely increases or decreases the existing excitation of the sensory cells, by pulling or pressing on the macula.

To localize the otolithic reflexes to the individual macula, the position of the macula was studied when the skull was in the position of space, in which the reflex was at its maximum, again when the reflex was at its minimum. The tonic labyrinthine reflexes, on the extensor muscles of the limbs, are maximal in the back position of the head, with the snout a little tilted, above the horizontal plane. This maximum is unaltered by unilateral labyrinthectomy, so we deduce that the maculae for these reflexes are in the same plane. It is found that here the utricles are horizontal, and the otolith membrane is hanging. In the minimal position for these reflexes, the utricles are again horizontal, with the otolith membranes pressing on the maculae. In the same way it is concluded, that the tonic reflexes for the neck and trunk are also from the utricles.

The vertical eye deviations depend on the saccule, because in unilateral labyrinth extirpation, there is vertical eye deviation, which means that the maculae in question are not in one plane. The deviation is maximal when the head is in the lateral position, with the intact labyrinth below. Here the saccular macula is horizontal, with the otolith membrane pulling. There is no deviation if the intact labyrinth is above.

The asymmetrical labyrinth righting reflexes bring the head from the lateral into the normal standing position. After unilateral labyrinth extirpation, they bring the head into the position where the intact saccular macula is horizontal, with its otolith membrane pressing.

The symmetrical labyrinth righting reflexes act to have the head held, so that of all possible symmetrical positions, the utricular maculae are horizontal, and the otolith membranes pressing.

This review shows that the utricles are the place of origin of the tonic reflexes on body musculature, and of symmetrical righting reflexes, whereas the saccules give rise to the asymmetrical righting reactions, and to the vertical eye deviations. The place or origin of the rotary eye positions is as yet unknown.

From the preceding evidence it is deduced that the minimum of stimulation is when the otolith membrane presses on the macula, and the maximum is when the otolith membrane is hanging from the macula.

A confirmation of these observations was obtained in another way. By injecting a small amount of cocain into the middle ear of a guinea-pig, there is a slow spreading paralysis of the internal ear. In the first stage, there is a vertical eye deviation, and a loss of the asymmetrical righting reflexes, from paralysis of the saccule which is just opposite to the oval window. The second stage is when the utricular macula is reached by the cocaine, and there is turning of the neck, due to loss of unilateral tonic influence, and there is unilateral abolition of the symmetrical righting reflex. There is

still response to the rotation and caloric tests, and there is no nystagmus. Thus, the nystagmus from unilateral labyrinth extirpation is due, not to the maculae, but to the ampullary apparatus of the opposite ear. This nystagmus occurs when the head is at rest, so is not due to endolymphatic currents, etc. Therefore it must be due to the excitation of the sensory epithelium of the crista ampullaris, which has the same physiologic behavior as the macula, continuous stimulation through the nerve, to the central nervous system.

The difference of function between the semicircular canals and the maculae, depends on the mechanical arrangement of the apparatus, connected with their epithelium. Evanescent currents, or pressure changes, are the stimuli of the ampullae. While the pulling of the otolith membrane is continuous, so long as the head is held in a definite position, it can cause constant change in the macular epithelium, which may thus produce tonic reflex action.

LABYRINTHINE COMPENSATORY EYE POSITIONS IN PATIENTS. A. DE KLEIJN and C. VERSTEEGH, J. Laryngol. & Otol. **39**:686 (Dec.) 1924.

Of the tonic labyrinthine reflexes, the rotary compensatory eye positions are the only ones that have found clinical application so far. From analogy with experiments on animals, these reflexes are thought to arise in the saccular maculae. The method described for measuring these reflexes is to place on the previously cocainized cornea, a small piece of the dried membrane from the under surface of the shell of a hen's egg, with a cross marked thereon. Spectacles with two thin wires at right angles in place of lenses are fixed before the eyes. A photograph of the patient then will show any rotary movement of the cross compared with the fixed wires of the spectacles. By projecting this picture on the wall, it is possible to measure accurately the angle of rotation. A photograph is taken, first with the patient in the normal sitting position, then with the patient lying on either side. Care must be taken to keep the head and neck symmetrical with the body. After each change of position, time must be allowed for reflexes from movement to subside. In the normal person, there may be a variation of from three to four degrees rotation when both sides are tested. When the patient is on the side, the lower labyrinth is the one being tested, because that is the position in which the saccular otolithic membrane is hanging.

In the table of results shown there are several normal cases, one case of bilateral loss of response, and two cases with unilateral loss of response, when the affected ear is below. Two of the cases illustrate an anatomic peculiarity of the internal ear. DeBurtlet has described a membrane which divides the internal ear into a pars superior including the semicircular canals and the utricle, and a pars inferior including the saccule and the cochlea. One case, after a suppurative otitis media on the right side, showed labyrinthine deafness. On examination, the function of the canals was normal. It was found that the counter rolling of the eyes in the right sided lateral position, was only 1 degree, whereas in the left sided position it was 11 degrees. In this case, the lesion was evidently confined to the pars inferior of the right internal ear. In another case, a child, aged 7, showed disturbance of equilibrium following diphtheria with acute suppurative otitis media. On examination, it was found that there was no response to the caloric or rotation tests on either side, the hearing was normal. There was normal compensatory rotary displacement of the eyes in both side positions. Here the lesion was confined to the pars superior of both ears.

MCNALLY, Montreal.

ON THE LOCALIZATION OF OTOLITH FUNCTION. S. S. MAXWELL, Laryngoscope **34**:849 (Nov.) 1924.

It has been emphasized that all vertebrates from the teleosts up, with the exception of mammals, have three otolith organs on each side; namely, the

maculae of the utriculi, the sacculi and the lagenae. It has been assumed by many that these three otoliths have to do with the posture reflexes, and stand in a definite relation to the lines of gravitational force in such a way as to form collectively an organ for static equilibrium. The tonus effects of these otolith organs are referred to as static reactions, and those from the semicircular canals as dynamic reactions.

Maxwell reviews carefully the experimental work done on the function of the otoliths, and reports results from researches carried on by himself which tend to prove a certain localization of otolith function within the three organs. Various investigators, working with guinea-pigs, obtained results very similar to each other, but these were so absolutely inconsistent with the results obtained on fishes and amphibians, that the author was led to review the latter experiments and carry on a number of his own. The large otolithic masses of the sacculi and lagenae were removed in the dogfish, but the small and rather inaccessible otoliths of the utriculi were left undisturbed. No disturbance of the static or dynamic functions occurred. These experiments did not sufficiently discriminate between the functions of the different otoliths and those of the other parts of the labyrinth; so again using the dogfish, the three ampullae of each ear were destroyed and the otoliths removed from the sacculus and lagena, with the retaining of all the compensatory positions when the fish was placed in any oblique position. When the remaining otolith, the macula utriculi, was removed, all reactions ceased. Mechanical stimulation of the macula utriculi produced movements of the eyes exactly like those resulting from the placing of the normal animal in any oblique position whatever.

A series of similar experiments were carried on in the frog by the author in conjunction with R. E. Orme, the results being the same as those obtained in the dogfish.

The conclusions are that in the fish and frog all the labyrinthine posture reflexes can be obtained through the action of the maculae utriculi alone, and that the otoliths of the sacculus and lagena have nothing to do with these functions.

SNAPP, Grand Rapids.

TWO CASES OF PERIMASTOID ABSCESS WITH CURE WITHOUT OPENING THE MASTOID CELLS. KOUTSORODIS, Rev. de Laryngol. **3**:95, 1924.

CASE 1.—A man, aged 41, was attacked by severe pain in the left ear, which discharged purulent matter after a few hours. Five days later, a painful swelling appeared in the retro-auricular area with very little mastoid tenderness. The external auditory canal was not painful on pressure and there was no swelling in the canal. Incision of the swollen area liberated a small quantity of pus. The symptoms gradually subsided and the wound closed.

CASE 2.—A woman, aged 55, developed an acute suppuration of the right ear. Soon after, a tumefaction developed over the mastoid and over the superior cervical region. On incision, a small quantity of pus was found. A counter drain was made over the sternomastoid. Exploration of the mastoid showed it to be normal. After the drainage of pus, the temperature fell, pain disappeared and healing of the wound was effected in a few days.

ROBERTSON, Chicago.

Pharynx

ASYMMETRY OF THE MOUTH OF THE ESOPHAGUS AND RETROPHARYNGEAL DIVERTICULAE. HARRIS P. MOSHER, Laryngoscope **34**:854 (Nov.) 1924.

In a series of studies and observations made by Harris P. Mosher on both anatomic specimens and clinical cases, he finds that asymmetry of the thyroid cartilage, the pyriform sinuses and of the mouth of the esophagus

is common. Postcricoid webs which turn one or both pyriform sinuses into pockets also are common. Retropharyngeal diverticulae or esophageal pouches are hernia of the esophageal mucous membrane through the anatomically weak spot of the posterior wall of the esophagus, and are believed by the author to be caused by asymmetry of the pharyngeal funnel due to asymmetry of the larynx, the pyriform sinuses or the mouth of the esophagus. A sufficient deformity of the pyriform sinus or of the mouth of the esophagus throws the muscle strain in swallowing off center, thus bringing about a tendency to pouching. Larger pouches appear to be pedunculated and often extend into the thorax. The width of the mouth of a pouch is the width of the lower pharynx, thus it is easy to enter the pouch. Experimental diverticulae show that the drag of the sac narrows the mouth of the esophagus to a slit, closely applied to the posterior surface of the cricoid cartilage. Reduction of the pouch or its ablation at once restores the lumen of the esophagus to its natural size.

SNAPP, Grand Rapids.

DISCUSSION ON CHRONIC TONSILLITIS: INDICATIONS FOR, AND RESULTS OF TREATMENT. A. BROWN KELLY, Brit. M. J. **2**:804 (Nov. 1) 1924.

The first condition considered was hypertrophy of the tonsils in children. Several references were quoted to show that the majority of tonsils are infected shortly after birth. The tonsil is just a part of the lymphadenoid tissue of the body, and if removed, the remaining lymphatic tissue in the pharynx hypertrophies. There is no hesitation in doing a tonsillectomy on a child as young as 18 months. Opinion is divided as to whether the tonsil predisposes to, or protects the child from the exanthemas. The tonsil is regarded as the main portal of entry for infection of the cervical glands. In these cases the tonsil is frequently infected with tubercle bacilli, and should be removed before the glands.

Singers with diseased tonsils are much benefited when a careful dissection is performed. In a series of 5,000 cases reported by Voorheese, this opinion was borne out.

The following factors must be considered when examining the tonsil for focal disease, namely: Is there any infection in the tonsil? Is it associated with the attacks of the systemic disease? Are there other foci of infection? There should be hesitancy before removing an apparently healthy tonsil because no other focus is discoverable. And, finally, systemic disease long present may not be much benefited, even with the removal of a definite focus of infection.

There is a large number of references giving the results following tonsillectomy for different conditions. Chronic toxemia is directly benefited. The rheumatic conditions are improved, and the percentage of recurrences reduced. Many investigators are dubious about the results obtained in rheumatoid arthritis. The benefit in chorea is doubtful. Acute and chronic nephritis patients have been improved. There has been decided benefit in a few cases of goiter and epilepsy. There are other general conditions mentioned as having been favorably influenced.

The author concludes that where no tonsillar infection can be detected, no enlarged glands found, and when the history does not show a relation between the rheumatic ailment and the tonsil, he would not recommend a tonsillectomy.

Two other paper are published on this subject; one by Dr. C. A. Scott Ridout, and the other by Dr. E. D. D. Davis. In the main their opinions coincided with those already expressed by Dr. Kelly.

After the general discussion, the following resolutions were suggested by Dr. Ridout, and were finally adopted by the Society:

1. That tonsillectomy by enucleation is the only effective method of procedure for tonsillar disease.

2. That tonsillectomy should be classed as a smaller "major" operation.

3. That tonsillectomy should only be undertaken after expert opinion has been obtained.

McNALLY, Montreal.

THE TREATMENT OF VINCENT'S ANGINA. P. MANGABEIRA ALBERNAZ, Arch. internat. de laryngol. **3**:917, 1924.

After a summary of the various forms of local and general treatment as advocated by various authors today, the author gives the histories of four patients who were treated by him with local applications of from 1 to 3 per cent. solutions of tartrobismuthate of soda and potash in emulsion of olive oil. As he states, his results are without parallel in rapidity of cure.

The application is made on a cotton applicator. If immediate result does not occur, the 3 per cent. emulsion is applied.

The author states that the application is free from danger even in 10 per cent. strength, and the application does not cause pain while improvement is very rapid.

ROBERTSON, Chicago.

Larynx

A SERIES OF CASES OF TUBERCULAR LARYNGITIS IN CHILDREN. C. D. S. AGASSIZ, J. Laryngol. & Otol., 628 (Nov.) 1924.

In the series of eleven cases quoted, all were under 16 years of age, and all but one showed tubercle bacilli in the sputum.

The most comon lesion noted in the larynx was a swelling and redness of the arytenoids, with or without tubercular deposits or ulcerations on the cords. There was evidence of scarring in a few cases, and the author thinks that healing may occur, but the series has not been followed over a long enough period to say definitely. The larynx was examined anywhere from three months to four years after the commencement of the illness. In all cases the lung involvement was advanced, and the infection of the larynx was most common in the more serious cases.

There is a short concise synopsis of eleven patients, all of whom showed laryngeal involvement.

In conclusion, he gives percentage of tubercular laryngitis in pulmonary disease. In seventy-two cases of pulmonary disease with tubercle bacilli in the sputum, the larynx was infected in 12.5 per cent. In 183 cases where the signs of pulmonary disease are not so evident, the larynx was involved in 5 per cent. of cases.

McNALLY, Montreal.

THE MITCHELL LECTURE ON TUBERCULOSIS OF THE LARYNX: ITS SIGNIFICANCE TO THE PHYSICIAN. ST. CLAIR THOMSON, Brit. M. J. **2**:841 (Nov. 8) 1924.

In England and Wales at present, there are 106,990 cases of laryngeal tuberculosis. The authors series comprises 477 cases from 2,541 cases of general tuberculosis seen.

The average of the decade showed that of the early cases of general tuberculosis, there were 18.77 per cent. with laryngeal involvement, whereas the necropsy records of this period showed a percentage of from 48 to 83.

In the Turban Gerhardt classification of tuberculosis, there are three groups: early, severe and advanced cases. In Group 1 the proportion of laryngeal cases is 4.8 per cent.; in Group 2, 18 per cent., and in Group 3, 31 per cent.

The sites of predilection in the larynx are in their order of occurrence, first in the posterior commissure and arytenoids, then on the cords, then in the anterior commissure, on the epiglottis, etc.

Of the cases of laryngeal tuberculosis treated at Midhurst Sanatorium, between the years of 1911 and 1921, 70.5 per cent. are now dead. The mortality

is higher in Group 1 cases, with laryngeal involvement, than it is in Group 2 when the larynx is free.

The principal factor in the cure of the disease of the larynx is rest. Complete silence resulted in the cure of twenty-three cases or 34 per cent. Whisper cured fifty cases or 14.7 per cent. The only local measure worthy of trial is the galvanocautery, used in selected cases after the patient has had vocal rest. Forty-six cases were cured, or 46 per cent. of number so treated. Of the 477 there were 119 patients cured. Some of these have died since from general tuberculosis, but there was no recurrence of disease in the larynx. The laryngeal condition may be clearing up, even though the pulmonary condition is becoming worse.

The author concludes that in the majority of cases, the prognosis is bad, but that some patients can be cured by early diagnosis and proper treatment.

McNALLY, Montreal.

NEURALGIA OF THE SUPERIOR LARYNGEAL AS A COMPLICATION OF EPIDEMIC GRIPPE. M. E. HALPHEN, Arch. internat. de laryngol. **3**:914, 1924.

For several years the author has treated the superior laryngeal with anesthesia by injections of alcohol in the trunk of the nerve, for such symptoms as are found from laryngeal tuberculosis, spasmodic cough, laryngotracheitis, laryngeal spasm, and latterly in conditions arising as a sequel of grip.

He has seen a large number of cases following epidemic grip and has been very much gratified at the relief attained and the permanence of the cure.

ROBERTSON, Chicago.

APPLICATION OF BRUEGGEMANN'S FORCEPS TO DRAW FORWARD THE LARYNX, AND THE SIGNIFICANCE OF ROENTGEN-RAY EXAMINATION IN EXTRACTING FOREIGN BODIES FROM THE ESOPHAGUS. PAUL TEICHERT, Ztschr. f. Hals-Nasen-u. Ohrenh. **9**:253 (Dec. 6) 1924.

A woman, aged 23, had swallowed, during the night, a dental plate with a sharp metal clasp. The plate stuck in the fore part of the esophagus directly below the mouth of the same. The esophagoscope, as is known, while introduced frequently slides abruptly several centimeters further and, thus, there was danger of injury by the clasp. Von Hacker has shown that this critical task can be more easily performed if one grasps the larynx with the fingers and pulls the same gently forward. In order to draw the larynx from the spine, Teichert uses the forceps which Brueggemann advised for hypolaryngoscopy. It could easily be used after injection of a few cubic centimeters of procain solution. Teichert gained the impression that the cramplike closure of the mouth of the esophagus yielded when the larynx was pulled forward. A second analogous case concerned a woman, aged 29. Seifferts' tube and Brueggemann's forceps were used successfully. In both patients a temporary infiltrative inflammatory process developed in the mucous membrane of the esophagus and in the periesophageal tissue. Roentgenograms showed the progress and the disappearance of the inflammation in conformity with the course of temperature.

Summary. 1. The method advised by Brueggemann concerning the drawing forward of the larynx facilitates the introduction of the esophageoscope very much, and the removal of foreign bodies, especially when they are situated high.

2. Roentgen-ray pictures, after injury of the wall of the esophagus, give exact findings concerning the extent and the retrogression of inflammatory processes in the periesophageal tissue, and they are therefore important aids for indicating surgical interference if necessary.

AMBERG, Detroit.

Nose

MUCOCELE OF ETHMOID WITH PROPTOSIS OF RIGHT EYE. RICHARD L. BOWER, Am. J. Ophth. **7**:218 (March) 1924.

Bower reports a case of mucocele of the right ethmoid, in a negro, aged 45, with the history going back ten years. About every week or two the right eye would protrude and accompanying the protrusion there was pain in the orbit and over the bridge of the nose. The protrusion was generally associated with a cold in the head, and as the cold would clear up the protrusion and pain would become less marked although at no time had the right eye appeared in its normal position.

Examination showed exophthalmos in the right eye of 7/16 of an inch with limited movements and diplopia. Fundus showed partial optic atrophy of the primary type with vision at five feet. A definite fluctuating swelling was present in the inner angle of the orbit without crepitation. Pressure on this swelling caused pain and increase of the exophthalmos.

The nose showed a septal deviation to the left with enlarged right middle turbinate. No pus was seen in the nose. Roentgenogram showed defective right ethmoids and slightly less clearness of the outline of the right frontal sinus.

Killian operation was done. The frontal sinus was found to be normal. A bluish, encapsulated fluctuating mass occupied the inner portion of the orbit and was connected with the ethmoid region. In attempting removal, the mass was ruptured, evacuating mucoid fluid. Following the operation the pain was relieved and exophthalmos on discharge was 3/16 of an inch.

ACUTE PURULENT ETHMOIDITIS IN A THREE MONTHS OLD CHILD. B. M. HOWLEY, Am. J. Ophth. **7**:458 (June) 1924.

Howley reports a case of a child, aged 3 months, with some discharge from the left side of the nose and marked swelling of the left side of the face with exophthalmos and orbital cellulitis. At operation through a 1 inch incision at the inner angle of the left eye, pus was evacuated and a probe met bare bone of cellular character. The ethmoid region was mildly curetted, followed by complete recovery.

MONOCULAR IRITIS FROM A FOCAL INFECTION IN THE NOSE AND THROAT. JAMES A. MORGAN, Am. J. Ophth. **7**:459 (June) 1924.

Morgan reports a case of acute iritis in the left eye where roentgen-ray examination showed marked clouding of the left frontal sinus and ethmoid region. Intranasal operation was done, consisting of submucous resection of the septum, intranasal drainage of the frontal sinus and exenteration of the anterior ethmoid cells. Thick, greenish pus was found in the frontal sinus. Tonsils were removed at the same time. For a period of twenty-four hours following the operation the iritis was intensified but recovery was complete.

TRICHINOSIS WITH PREDOMINANT SYMPTOMS REFERABLE TO EYES AND FRONTAL SINUSES. JEROME B. THOMAS and WARD COOPER, Am. J. Ophth. **7**:511-512 (July) 1924.

The authors report a case of a man, aged 35, who complained of edema of the eyelids and pain in the frontal region. He gave a history of having been out of sorts for three weeks previously, with sore joints and muscles and feverish attacks.

Examination showed the upper and lower lids of both eyes quite edematous with marked chemosis. The nose and throat were negative except for slight catarrh. The following day the edema had increased and was present over the malar and temporal regions. The temperature was 103 F. Roentgen-ray

plates showed decided opacity over the site of the right sphenoidal sinus, the same side as the more painful eye. All the sinuses including the frontals were indistinct in outline. Orbital abscess and empyema of the right sphenoidal sinus were suspected, and the following day the right sphenoid sinus was irrigated and a clear washing obtained.

The next day examination of the blood revealed an eosinophilia of 30 per cent., and the diagnosis of trichinosis was suspected and later confirmed by examination of a bit of gastrocnemius muscle, which showed numerous encysted trichinae.

REPORT OF TOTI-MOSHER OPERATION ON A CHILD FIVE YEARS OF AGE. W. G. KENNON, Am. J. Ophth. **7**:542 (July) 1924.

Kennon reported this case at the meeting of the Nashville Academy of Ophthalmology and Otolaryngology, Feb. 18, 1924, and wishes to bring out the fact that this was the youngest patient on record on whom a Toti-Mosher operation had been done. This was reported by Dr. Hilliard Wood.

ETIOLOGY AND TREATMENT OF OCULOMOTOR DISTURBANCES. THOMAS FAITH, Am. J. Ophth. **7**:610-618 (Aug.) 1924.

Faith in his paper discusses the nerves which preside over ocular movements, in other words, the third, fourth and sixth cranial nerves and the sympathetic which supply the dilator pupillae and the long list of conditions which can affect them.

In discussing the subject, he states that disease of the accessory sinuses of the nose, particularly the ethmoids and sphenoids, can cause oculomotor disease, usually through orbital involvement. These cases are characterized by the implication of a single muscle usually, and most of them clear up except where severe cellulitis or orbital abscess is present. Cases may, however, occur in which the neurologic or brain lesion due to the sinus disease may be the cause of the oculomotor disturbance. Occasionally an operation on the frontal sinus, such as the Killian operation, may be the cause of a paralysis of the superior oblique muscle through injury to the pulley or to the muscle itself, or the superior rectus may be injured by the same operation.

H. H. VAIL, Cincinnati.

BLINDNESS OF OBSCURE NASAL ORIGIN. WILLIAM HUMES ROBERTS, Arch. Ophth. **53**:19-25 (Jan.) 1924.

Roberts states that it has long been recognized that various degrees of loss of vision up to complete blindness of one or both eyes can be caused by readily diagnosed disease of the accessory sinuses, producing retrobulbar optic neuritis. In his paper he wishes to call attention to the fact that the same eye condition is frequently the result of obscure nasal disease. These patients are, as a rule, first seen by the oculist, who on referring them to the rhinologist for examination, gets back his report "nasal findings negative."

The author cautions against a hasty diagnosis. Brain tumors, organic brain disease, pituitary disease, multiple sclerosis, toxic amblyopia, toxemia, diabetes, syphilis and the optic nerve changes due to primary eye disease must be ruled out before attempting intranasal surgery. An operation on the sinuses for the relief of blindness caused by any of the aforementioned diseases will not only relieve the progressing loss of vision but will bring into disrepute intranasal operations, and possibly prevent their employment on any patients in which they are urgently required. Van der Hoeve says: "The ophthalmologist has in the eye no sign at all to distinguish the origin of a retrobulbar neuritis, the rhinologist cannot say with absolute certainty that a person has no sinus infection."

The author insists on the importance of a careful examination of the visual field, as well as the usual ophthalmoscopic examination. Nasal symptoms may be entirely lacking or only those of a head cold. Examination of the nose and sinuses may show no nasal pathology or a high posterior deflection of the nasal septum, with some hypertrophy of the middle or superior turbinate may be noticed. The size and position of these turbinates is of great importance, for if there is any interference with the ventilation or aeration of the posterior sinuses there is sufficient pathologic change to cause a retrobulbar neuritis on slight provocation. It is because, according to the author, no two rhinologists see alike on this particular point in intranasal examination that we frequently get from them the report of negative nasal findings.

The author insists that the treatment is surgical, and consists in uncapping the posterior ethmoid cells and in opening the sphenoid sinuses on the side or sides involved. Radical work on these sinuses is not necessary.

He also wishes to make a plea for exploratory operation in these cases in which, by exclusion, we are forced to the conclusion that sinus disease, even though none can be demonstrated, is the cause of the trouble.

The author reports a case where nasal examination showed nothing abnormal and the diagnosis had to be made by exclusion. At the operation no evidence of any sinus disease was found. Within three weeks after the operation vision had improved from 1/100 to 6/6—. The author gives thirteen references to literature on the subject.

AN UNUSUAL DERMOID CYST. HARRY S. GRADLE and JULES C. STEIN, Arch. Ophth. **53**:254-257 (May) 1924.

The authors report a case in a youth, aged 17, where a dermoid cyst was present in the right upper eyelid extending into the orbit and subcutaneously onto the forehead. The tumor was the size of a large walnut, was rather movable but could not be compressed or reduced in size. Pressure on the mass toward the frontal bone caused a dull headache, while increased pressure was painful and nauseating. The tumor had been present since birth. Roentgen ray revealed a defect in the bone as the result of the tumor.

This tumor was removed by operation from the tissue of the lid and orbit, and on removal a depression was found in the frontal bone corresponding to the bed of the tumor. Examination of the tumor showed it to be a unilocular cyst with a tough covering. This cyst contained a yellowish, sebaceous cheesy mass with some fine hairs within.

The pathologic diagnosis was dermoid cyst.

A differential diagnosis of hernia cerebri was discussed.

H. H. VAIL, Cincinnati.

EDEMA OF EYELIDS. S. JUDD BEACH, Tr. Sect. Ophth. A. M. A. 1924, pp. 138-158.

Beach, in a complete and well written article with bibliography, discussed the question of edema of the eyelids. In discussing solid edema of the eyelids, he thinks the relation of nasopharyngeal infection to solid edema of the eyelids, as brought out by Levraud in 1889, and Weaver and Tunnicliff in 1908, could not explain all cases of solid edema of the eyelids. He states it must be granted there are times when the nasal complication is absent or at least not evident, and he feels that the disease may indicate in rare individuals an abnormal weakness of the defense mechanism against the common skin cocci.

The author touches on edema of the eyelids found with obvious nasal sinus disease, and discusses the evanescent swellings which may be due to focal infection, anaphylaxis, trauma, endocrine disturbances and general physical conditions. He feels that the edema occurs in the eyelids before appearing elsewhere in the body, and it is a common observation that occasionally this swelling is the sole evidence of disorders more or less grave.

H. H. VAIL, Cincinnati.

LUPUS OF THE LACRYMAL SAC. R. R. JAMES, Brit. J. Ophth. **8**:158-165 (April) 1924.

James reports a case in which definite evidence of tuberculosis was found in the tissue removed from the nasal mucosa and from the region of the lacrymal sac. The patient was a woman, aged 26, with a left sided lacrymal abscess, epiphora and a discharging lacrymal sinus. There was a peculiar appearance over the soft parts of the nose on each side. This was shiny, slightly reddened but not ulcerated and the terminal part of the nose was slightly red and bulbous. The interior of the nose at a later observation was found to be completely blocked by large crusts.

Operation consisted of removal of the tear sac, and at that time examination of the nose showed an extensive ulceration reaching over the outer wall and onto the septum.

The pathologic report was that the tissue removed from the nose and tear sac region was full of giant cell systems, characteristic of tuberculosis, with added evidence of pyogenic infection. The guinea-pig inoculated with the tissue showed extensive tuberculosis when it was killed.

H. H. VAIL, Cincinnati.

CONTRIBUTION TO THE SURGERY OF THE FRONTAL SINUS AND OF THE ANTERIOR ETHMOID CELLS. R. GUMPERZ, Ztschr. f. Hals- Nasen- u. Ohrenh. **9**:291 (Dec. 6) 1924.

Halle's procedure has not been extensively used, perhaps on account of the narrowness of the field of operation. The field of operation must be made more visible and larger, hammer and chisel must be used as little as possible, and finally, the chisel must not be used, if possible, perpendicular to the base of the skull. Gumperz claims that his method, the submucous resection of the processus frontalis of the upper jaw, fulfills these demands and also that there is no outer scar, because it is performed from the apertura piriformis. The operation is performed as follows: After injection of morphin-atropin, and cocainizing the nose, infiltration anesthesia of the nasal and external surface of the processus frontalis of the upper jaw is used. A liberal submucous injection of 0.5 of 1.00 per cent. procain-epinephrin solution under the mucous membrane of the middle nasal meatus is sufficient for anesthetizing the nasal surface of the processus frontalis. The outer surface of the upper jaw is infiltrated through the mouth, especially the infraorbital nerve. Close to the lateral free border of the apertura piriformis, at the vestibulum nasi, a hollow needle, about 8 cm. in length, is introduced and it is slowly pushed on, controlled under the skin. The injection is carried out under even pressure, upward at least as far as the nasofrontal suture. The bleb formation can be watched with exactness. It must reach to the region of the glabella and at least include the middle third of the eyebrow. With this procedure, the conduction, anesthesia of the ethmoidal nerve, which is not without danger, is entirely superfluous. The incision is identical with that in Denker's operation. The soft parts covering the frontal process must be pushed very far upward on the external surface of the upper jaw until the crista lacrimalis anterior and the sutura nasofrontalis are made visible. With a septum elevator, the mucous membrane of the middle nasal meatus is lifted until the region of the processus uncinatus is reached. Thus the processus frontalis of the upper jaw is laid bare like in the skeleton. In order to get a good view of the field of operation, Gumperz designed two hooks, by the aid of which the soft parts of the cheek and of the nose, and on the other hand the mucous membrane of the middle nasal meatus can be held. The hooks are 22 cm. long, the handle serves as a mouth angle hook. At the other end the hook ends in a shank 5 mm. wide, bent at an angle of 80 degrees. This shank is lightly serrated in order to prevent its sliding off. If the hook is

correctly placed, the bare processus frontalis shows itself completely. In order to resect it, Gumperz designed a special bone forceps, because those on the market are either too short or too weak, in order to remove the processus frontalis which is sometimes compact, especially in its upper portion. No other bone forceps allowed a sufficient view when working in the depth. The same instrument can be used to advantage in Killian's operation for the resection of the floor of the frontal sinus, in Denker's operation, for the resection of the lateral wall of the nose of the lower nasal meatus; and also in the peroral dacryocystorhinostomy. It is easy to resect the processus frontalis way up with the aid of this forceps, starting at the free border of the apertura piriformis, using as goal the point at which the os frontale, the processus frontalis of the upper jaw and the os lacrimale unite, namely, the highest point of the crista lacrimalis anterior. Now a mucous membrane flap is made from the middle nasal meatus, in order to get a comprehensive view of the ethmoid region. If there were prelacrimal ethmoid cells, they have been removed during resection of the uppermost portion of the processus frontalis because one had gone as high as possible. The mucous membrane of the middle nasal meatus, so far intact, is separated transversely, as high as possible. A second incision also starting as high as possible under the roof of the nose, about perpendicular to the first, is made close to the roof of the nose and parallel with the same downward to the level of the lower turbinate. This flap is held in place toward the septum by the medial hook and an excellent view of the ethmoid region is obtained. Now, if it was not done before, the processus uncinatus is resected. The bulla ethmoidalis was probably removed before it was decided to employ this procedure. With conchotome and punch the anterior ethmoid cells are easily removed. With a few light chisel blows, approximately parallel to the base of the skull, the still remaining uppermost parts of the processus frontalis are removed, until a very free view of the most anteriorally located ethmoid region is obtained. The uppermost part of the processus frontalis resists the forceps on account of its strength. Now the massive bone of the floor of the frontal sinus can be thinned from backward, forward, by chisel, burr or rasp. Just like in Halle's operation, one is always surprised at the excellent view of the frontal sinus. The mucous membrane flap is then placed on the lateral respectively anterior nasal wall and kept in place by very light tamponing. The wound in the mouth is closed by an uninterrupted catgut suture. This procedure, compared with that of Halle is, no doubt, more extensive, but if one considers that the view is essentially better, that the surgeon can use both hands, that the hammer and chisel are much less used, and that the direction of the work with the chisel is made less dangerous, Gumperz thinks that his method can be recommended for trial.

AMBERG, Detroit.

Miscellaneous

CELLULITIS OF THE ORBIT IN INFANTS AND CHILDREN WITH A REPORT OF TEN CASES. KENNETH A. PHELPS, Ann. Otol., Rhinol. & Laryngol. **33**:1391-1400 (Dec.) 1924.

Phelps is of the opinion that children are very much more subject to orbital cellulitis than has been recognized heretofore. It is his belief that all cases of orbital cellulitis have their origin in disease of the nasal accessory sinuses, and that several important anatomic conditions of the sinuses and orbit in children favor and contribute to the development of the orbital complications of sinusitis. These anatomic conditions, the author states, are congenital dehiscences along the ethmomaxillary suture, in the lamina papyracea or in the orbital wall of the maxilla. The orbital bones are softer in children, ossification not being complete until the sixteenth year and nonclosure of

the sutures until the sixth year. The orbital periosteum is thin and delicate, and is adherent at the sutures where in early life it is continuous with the periosteum covering the opposite side of the bone.

Armstrong and Dean believe that in cases of equal clinical severity with equally marked changes in the mucous membrane, there is much more apt to be involvement of the underlying bony wall in the child than in the adult. The final anatomic condition is a more profuse development of the lymphatic and vascular system in the child than in the adult. Infection from the sinuses may enter the orbit along the veins without any bony perforation.

According to the author, pus in all cases does not perforate into the orbit; it may be guided anteriorly beneath the periorbita until it points through the eyelid where it sometimes ruptures spontaneously. The author compares the frequency of subperiosteal abscess of the mastoid in children, and states one should realize that the same condition can occur in the orbit as a result of infection in the nasal sinuses.

Phelps mentions several other causes of orbital cellulitis, namely, trauma, carious teeth, osteomyelitis, erysipelas, meningitis, brain abscess, the exanthems, metastasis, actinomycosis, but he feels that these causes are infrequent when compared with the nasal sinuses.

The first symptom of orbital cellulitis is sudden edema of the eyelids, which in all probability, closely follows the rupture through the periorbita. The edema increases very rapidly, so that within twenty-four hours the eyelids can only be opened with difficulty. Chemosis is usually present and frequently it gives a valuable clew as to the exact location of the pus in the orbit, as with the chemosis on the nasal side the pus will be found in the nasal portion of the orbit, and with chemosis on the temporal side the pus will be found on that side. Following the chemosis, proptosis takes place and this often affords a valuable clew as to the location of the pus. Other symptoms are limited extra-ocular movements. In children it is difficult to get a history of diplopia. The author states that examination of the fundus usually discloses dilated retinal veins. There may be cases of indentation of the globe simulating detached retina, choked disc, optic atrophy, optic neuritis, retinal hemorrhages or retrobulbar neuritis but the author has never happened to observe any of these.

The general condition of the child appears serious with high temperature, marked prostration and signs of sepsis.

The nasal examination is important, as frequently little can be obtained from the history. Phelps feels that the most valuable single diagnostic aid is the roentgen ray; but the value of the roentgen ray in the diagnosis of the orbital condition is limited.

Streptococcus hemolyticus was found in every case in which he made a culture. Early diagnosis is important, as in that stage prevention of orbital complications can often be accomplished and frequently by nonoperative measures; but once the orbital contents are involved, immediate operation should be done. In the case of very small children, intranasal drainage of the orbit is not satisfactory. If free pus has formed in the orbit it should be drained externally at once.

The author gives his technic of operation, using a curved incision almost identical as that used in the extirpation of the lacrimal sac with elevation of the periosteum of the lacrimal bone and the os planum. The eyeball is retracted, and the tiny ethmoid cells are broken down by a Pratt curet and free drainage established into the nose. The antrum should be opened from above in very young children, but through the inferior meatus when possible and the frontal and sphenoid sinuses explored when indicated. Drains are left in the nose for twenty-four hours and the incision should be left almost entirely closed. Adenoids should be removed. In case exophthalmos is marked, considerable care should be taken of the cornea.

The author describes in detail case reports of ten cases, an infant of 5 months, a child of 1½ years, one of 2 years, two of 3 years, two of 6 years, one of 7 years and one of 10 years. The last case he reports is one of a child, 3 years old, with a brain abscess, who died, and at necropsy a large temporal lobe abscess was found which had perforated the orbit and the superior orbital fissure, remaining external to the periorbita, extending the entire length of the orbit and breaking down at the external canthus. A localized meningitis surrounded the abscess; the middle ear and mastoid contained seropurulent material and the tympanic membrane was thickened but intact. In commenting on this last case, the author states he has been unable to find in the literature a report of any case where a brain abscess has broken through the orbit and has produced an orbital abscess.

H. H. Vail, Cincinnati.

Observations on the Technic of Bronchoscopy for Diseases of the Lungs. W. F. Moore and R. M. Lukens, Laryngoscope **34**:879 (Nov.) 1924.

In discussing the technic of bronchoscopy for diseases of the lungs, Moore and Lukens take up the subject under six heads, namely: selection and preparation of the patient, armamentarium, forms of treatment, care of instruments, after care and bacteriologic examination.

The authors stress the great importance of a thorough preliminary study of all these cases, including an examination by the internist, the roentgenologist and the bacteriologist. To secure the confidence of the patient is of the greatest value. No general anesthetic is used. A full equipment of instruments must be ready at hand in case any emergency should arise. The constant endeavor in all forms of treatment should be to secure the best possible drainage of the affected area. The usual routine is to make a preliminary diagnostic bronchoscopy, noting the general condition of the tracheobronchial tree and obtaining specimens for examination. The form of treatment to be carried out at the second bronchoscopy then depends in part on the reports from the internist, roentgenologist and bacteriologist. A thorough aspiration of the affected area is attempted, and a 10 per cent. solution of silver nitrate applied to the granulations about the bronchial orifices. In irrigating, 2 grains of trinitrophenol and 1 dram of compound solution of iodin in 1 pint of physiologic sodium chlorid solution is used. After the irrigation is discontinued, mineral oils or gomenal, in 20 per cent. solution, are instilled while the bronchoscope is still in position. Posture to facilitate drainage between the weekly treatments is of great value, and at night a sleeping position on the sound side is recommended. Vaccines are given at four day intervals as part of the after care.

Frequency of Thymus Cases. Harris P. Mosher, Laryngoscope **34**:900 (Nov.) 1924.

Mosher reports the results of a routine measure in the throat department of the Massachusetts General Hospital and the Massachusetts Eye and Ear Infirmary to radiograph all children, from 1 to 14 years of age, who were admitted for the tonsil and adenoid operation. All children showing a broad superior mediastinum were considered as suspicious thymic cases, and were given four roentgen-ray treatments at ten-day intervals, of a third of an erythema dose. The total number of children irradiated was 2,344. Of these, 185 or 7.5 per cent., showed a positive thymus shadow. Of the 185 positive cases, 110 have been treated and successfully operated on. Ninety per cent. of the children treated showed a diminution of the broadness in the superior mediastinum.

Snapp, Grand Rapids.

A Classification of Chorea in Relation to Its Causes. C. J. MacAlister, Brit. M. J. **2**:849 (Nov. 8) 1924.

Chorea is considered as a symptom and the causes are classified under three headings: 1. Rheumatic or toxic type. 2. "Stockbrained" cases, related to an inherited tendency. 3. Climacteric type. In this article the author does not consider the first class of cases.

In the second class there was usually a history of either the child or some of its relatives being left handed, in a few cases there was a history of both left handedness or stammering. The author quotes eleven cases showing this association in the history. The attack of chorea is usually precipitated by a sudden shock or fright. He thinks the choreic movements are probably due to gross motor ataxia analogous to the stammering.

Hughlings Jackson regarded the left speech center as leading, and the right as automatic. Now when a stock brained influence impresses a tendency of automatism in a leading center, or for an automatic center to take on leading functions, it is easy to understand incoordination. The slender balance is upset by sudden fright, etc. He quotes the case of a left-handed boy, who only stammered when they made him use his right hand to write with. He quotes three cases of congenital aphasia with stockbrained histories.

The third type consists of girls at puberty showing choreic movements, associated with symptoms of thyroid enlargement, etc. These are probably due to a metabolic incoordination, whereas, the case of Class 2 are probably due to anatomic incoordination.

McNally, Montreal.

A Large Beef Bone in the Esophagus Not Discovered at the First Esophagoscopy. G. Dutheillet de Lamothe, Arch. internat. de laryngol. **3**:928, 1924.

A man, aged 53, came to have a beef bone removed from the esophagus. The radiographic plate revealed the presence of a large, triangular bone in the esophagus with the point downward, lodged behind the thyroid cartilage. On examination with an esophageal tube, 11 cm. in diameter, the tube passed without obstruction to the cardiac level without encountering the foreign body. Retrograde examination failed to bring the body into view and it was concluded that the bone had been dislodged and had passed spontaneously into the stomach. A second radiographic plate, however, revealed the foreign body to be in the same place as prior to passing the esophagoscope. The patient also experienced the same sensation of a foreign body as before.

The esophageal tube was again introduced and passed without obstruction just as before. Again withdrawing the tube and making a lateral movement of the handle of the instrument something white was seen. Introducing a grasping forceps the bone was seized but could not be brought into the lumen of the tube, therefore the tube and bone were removed at the same time. The dimensions of the foreign body were, 7 cm. in length, 3 cm. in width and several millimeters in thickness.

As soon as it was removed all symptoms disappeared, the patient being able to swallow a morsel of bread immediately.

The foreign body lay parallel to the posterior vertebral wall, allowing the tube to pass easily in front of the bone. It could not be recognized as it appeared to be the wall of the tube.

This is the largest foreign body the author has seen in the esophagus.

Robertson, Chicago.

Society Transactions

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY

H. W. Loeb, M.D., *President*

Thirtieth Annual Meeting, May 29-31, 1924, St. Louis, Mo.

President's Address

In a long and comprehensive review of the papers published by the Triological Society, the author presented the essence of the more important contributions to otolaryngology which were made by its members. He first divided the review into the following headings, under each of which were listed the men who have distinguished themselves in that particular field: Anatomy, Physiology, Pathology, Bacteriology, Diagnosis, Metagnosis, Clinical Observation, Nonsurgical Therapeutics, Surgery, Ocular Relations, Borderline Surgery, Endoscopy, Radiology, Speech and Hearing Defects, Tuberculosis, Cancer, Unusual Cases, Instruments.

In a separate division of the article, the author gave an alphabetical list of the members who have been outstanding contributors to the literature, and under each name mentioned the more important and unique subjects which have occupied the member's attention during his membership in the society.

The author thus took a general account of stock, and gave due recognition to the many earnest workers who have done so much to advance the science of otolaryngology.

Observations Concerning the Relation of Endocrine Changes to Sphenopalatine Neuroses. Presented by Dr. E. T. Senseney.

The author described the so-called pituitary headache, with a distribution similar to Sluder's ganglion neuralgia, but unrelieved by cocainization, which yielded promptly to pituitary extract. Similarly, certain types of hay-fever have been influenced by thyroid extract, as have also headaches due to disturbances in ovarian and testicular secretions. In this connection, the author described Sluder's nasal ganglion neurosis and its relation to the menstrual period, showing the relief afforded by cocainization. By way of illustration, he quoted cases of headache following ovarian operations which were relieved by glandular therapy, but not by cocainization of the ganglion. Various theories were advanced to explain these results, such as increased irritability of the sympathetic nerves under nervous strain.

The Relation of the Nose and Throat to Endocrine Disturbances. Presented by Dr. E. A. Looper.

The author cited the importance of the endocrines and their interrelation, and gave a list of the most important of them. He showed that pharyngeal infections can by direct contiguity affect the pituitary gland, as evidenced by the fact that abnormal pituitary function is often benefited by adenoidectomy. Poor nasal ventilation is sometimes insufficient to explain the symptoms present. In the same way the thyroid is prone to infection via the tonsils and teeth, and the removal of the latter frequently results in improved thyroid function. Likewise the spleen and ovaries may receive infection from the tonsils, and it is well known that nasal pathology influences menstruation. Even the pancreas is not immune and the author cites five cases of glycosuria cured by the removal of nasal or throat growths.

RESULTS OF SURGICAL TREATMENT OF CANCER OF THE LARYNX IN LIGHT OF MOST RECENT STATISTICS. Presented by DR. JOHN SENDZIAK.

The author opened his subject with a brief account of the origin of the Triological Society. This was followed by a summary of the 1,718 cases of cancer of the larynx which he collected from the literature, comprising operative procedures classed as endolaryngeal, thyrotomic, partial and total laryngectomic and other methods. Of the endolaryngeal there were 15 per cent. absolute recoveries, 23 per cent. relative, 40 per cent. recurrences and no deaths. The distribution of these cases by nations is appended. With thyrotomy there were 23 per cent. absolute, 45 per cent. relative recoveries, 30 per cent. recurrences, 4 per cent. deaths. This method is useful in early intrinsic cases. With partial laryngectomy there were 20 per cent. absolute, 15 relative recoveries, 25 per cent. recurrences and 13 per cent. deaths. With total laryngectomy there were 13 per cent. absolute, 19 per cent. relative recoveries, 13 per cent. recurrences and 25 per cent. deaths. The article closes with statistics of the rarer methods. Throughout, there is frequent mention of the names of the men who have done the bulk of this hazardous work.

DEFICIENT VITAMIN DIETS AS A FACTOR IN OTOLARYNGOLOGICAL DISEASES. Presented by DR. J. A. STUCKY.

The importance of the prevention of many diseases by a properly balanced diet, the harmful effects of preserved and overrefined foods, and the benefits obtained by use of food waste products are well-known facts, exemplified in the treatment of tuberculosis and in present day life insurance statistics.

Foods having the greatest protective value are whole grain, milk, eggs, roots, greens, nuts and fruits. These will furnish a proper balance of carbohydrate, fat and protein, but mineral salts and some waste (roughage) are also essential, being supplied by whole grain, vegetables and fruit.

Several workers have experimented on the effect of varied diets on the growth of lymphoid tissue in cats (tonsils and intestines), and have found the amount to vary greatly with the caloric and fat percentage. High fat and high caloric diets gave the greatest increase in size to the tonsil.

The greatest single dietary deficiency is fat-soluble vitamin A, supplied by eggs and milk. To its lack may be attributed many eye diseases, aural toxemias, and so forth, another factor also being a mixed glandular deficiency. Failure of a patient to improve after tonsillectomy is often due to dietary imbalance. For such the author considers as a well balanced diet per day: 1 quart of milk; 1 egg; whole wheat bread at two meals; butter; three vegetables besides potato; cereals; three fruits (one raw); meat for older children; cod liver oil (for vitamin A deficiency).

Personal observations on the health of the Kentucky mountaineers lead the author to consider proper diet as a most potent factor in the eradication of nasopharyngeal diseases.

DISCUSSION

DR. E. W. DAY described his work with the same mountaineers with whom Dr. Stucky worked, and their improvement on the introduction of a properly balanced diet.

DR. L. W. DEAN described his own routine method for investigation of the dietary needs of his hospital patients and the importance of being sure that the patient actually eats the diet prescribed. He mentioned the rarity of ear and sinus infections in the metabolism ward where diet is the first essential, and told of Dr. Daniel's work with rats on a diet lacking fat-soluble vitamin A. The need of early treatment and the importance of sunlight was emphasized.

DR. G. F. KEIPER reported similar work in the production of ear and sinus disease in rats by dietary deficiencies and the importance of pure cod liver oil as tried out on the cat.

Dr. B. R. Shurley recounted his experience in the treatment of thyroid disease and cervical adenitis by dietary measures, particularly in the use of raw vegetable juice.

Dr. J. E. Logan urged the importance of a thorough estimation of a patient's general condition, aside from the immediate surgical indications.

Dr. B. W. Colver mentioned city conditions where the poor children receive better balanced diets than the rich, also the necessity of a proper balance of vitamins and mineral salts.

Dr. W. H. Haskins described a nutrition clinic lunchroom, run by a church for schoolchildren, and the resulting improved health of the children.

Dr. J. F. Culp mentioned a family where the children were chronically undernourished on a diet lacking vitamins, through parental phobia of germs in unsterile food and the results of sending them away from home.

Dr. Stucky (closing), urged the need of a balanced point of view on the subject, and a realization of a broad medical outlook in a specialty.

Nasal Hygiene. Control and Prevention of the Common Cold and Other Respiratory Infection Through Nasal Development. Presented by Dr. W. L. Culbert.

The author showed that the frequency of the common cold is the result of modern conditions of living and breathing. The modern nose is underdeveloped, is narrow and crowded, and mouth breathing is the ultimate effect. There is improper evaporation of the nasal cavities and the secretion in them as a result of congestion and subsequent infection. Nasal secretion is bactericidal, and hence low nasal resistance means low general resistance. A coryza is nature's effort to wash out infectious material. The author has devised expulsive breathing exercises designed to correct defects in nasal development and bring about a more normal and healthy type of breathing. They consist essentially in repeated forced expirations through the nostrils, followed by deep full inhalations, carried out conscientiously and repeatedly at home. They may be aided at first by nasal shrinkage with epinephrin, and are enforced by movements of the arms. The results in the author's experience are freedom from colds, less trouble from all kinds of nasopharyngeal pathology, including tonsils and adenoids, and better general health. Vaccines are of little avail, chlorin is simply an artificial coryza. The author has done much less nasal surgery as a result of these exercises, as shown by a series of case reports grouped under the various structures affected. Surgery is indicated in definitely obstructive lesions but proper nasal breathing is essential to ensure a good result. This work should be made prophylactic in children as they grow up.

Photography of the Larynx. Presented by Dr. Louis C. Clerf.

Good photographic reproductions of the larynx are of immense value in the study and teaching of laryngeal physiology and pathology, the first efforts along this line being those of Lennox Brown, in 1883, who, however, predicted little future progress. In 1884, Thomas French obtained some successful pictures by the use of condensed sunlight reflected from a head mirror and thrown on the laryngeal mirror. The image of the larynx was reflected back onto the photographic plate. The difficulties incident to the use of sunlight were obviously numerous.

In 1919, Garel of Lyon devised a stereoscopic camera, with illumination furnished by a tungsten lamp equipped with a resistance coil to permit over-illumination, so arranged that both the camera shutter and the coil were controlled by a foot pedal. The light was reflected onto the laryngeal mirror and thence to the larynx, the image following a reverse course and being caught on a photographic plate.

The author described his work with this apparatus, enumerating his initial difficulties in developing a satisfactory technic, particularly with regard to matters of illumination and securing a proper focus in larynges of varying size and depth. He also outlined some of the problems in this line still awaiting solution, on which he is at present working.

The article was illustrated by sketches of the apparatus devised by French and of Garel, together with stereoscopic views of the larynges of twenty patients, showing various types of laryngeal pathology.

PRESENTATION OF A NEW INSTRUMENT FOR FUNCTIONAL TESTS OF HEARING. THE AUDIO AMPLIFIER, DESIGNED BY DR. I. H. JONES AND V. O. KNUDSEN, PH.D. Presented by DR. E. R. LEWIS.

The inadequacy and inaccuracy of the commonly employed tests of auditory function are well known. Great advance has recently been made by the development of the vacuum tube, which functions both as an oscillator and as an amplifier. As the former, it is the basis of the audiometer, a new electrical device for the measurement of hearing for routine scale tones of all intensities. It is in its capacity as an amplifier that the vacuum tube has been utilized by the authors to furnish a combined apparatus for the amplification of conversational voice and whisper, in the detection of malingering, as a quantitative test of bone conduction, and as a noise apparatus. To this is added the beforementioned audiometric tone testing attachment. In addition, it is possible to selectively amplify the voice so as to emphasize either high or the low tones independently.

For testing purposes deafness is classified as (1) obstructive, (2) fixational and (3) perceptive. Deafness of the first class results in diminished perception for all tones of the scale equally, while that of the second class gives a diminished acuity for low tones, due to the fact that these require a stapes displacement about 25,000 times greater than the high tones, and hence are first affected by a fixation of the footplate. Deafness of the third class, due to cochlear or eighth nerve lesions, results in loss of high tones, since the more vulnerable and delicate portion of the cochlea are concerned with perception of these tones.

Appropriate speech amplification is of the greatest value in obstructive deafness; of least value in perceptive deafness. The use of selective amplification, however, furnishes three possible types of increased audibility: 1, uniform amplification, 2, low pass amplification (large amplification of low tones and slight amplification of high tones) and 3, high pass amplification (vice versa). Thus the differences in fixational and perceptive deafness can be partially met by selective amplification where uniform amplification would be useless.

A technical description of the audio amplifier was given and its various attachments explained. The method of a routine examination of a patient was outlined with the procedure for the determination for the type of deafness and percentage loss in hearing, both for conversation with the amplifier and for tone with the audiometer.

This apparatus serves also as a guide as to what form of apparatus as an aid to hearing is best suited to a given patient, and the authors are at present at work on such an apparatus of their own.

DISCUSSION

DR. R. SONNENSCHEIN discussed a comparison of the authors' audiometer with the audiometers of Dean, Kranz and the Western Electric Company, particularly with regard to their range for ordinary frequencies of speech.

DR. G. W. MACKENZIE mentioned the expense of such instruments as likely still to necessitate the use in the office of the standard methods of testing hearing.

Dr. L. W. Dean cited the great help furnished by the audiometer in testing the entire tone range, in locating remaining isolated islands of hearing, and in testing series of normal persons for statistical purposes.

Dr. G. E. Shambaugh mentioned the possibility of nerve deafness being manifested by an early loss of low tones, not high ones. Only patients with fixation deafness are aided by mechanical hearing devices, and it is often essential to intensify one part of the scale without the other.

Dr. M. A. Goldstein brought out the applicability of the audiometer in the testing of bone conduction. There is a need for the instrument in all large cities available for outside practitioners, who can thus receive accurate reports on their patients of which permanent records can be kept.

Dr. Knudsen (closing) emphasized the usefulness of the audiometer in research investigations of hearing. The authors claim no priority in the instrument itself, but merely its combination of the various features.

Some Aspects of the Problem of Testing Audition with Demonstration of a New Portable Apparatus. Presented by Dr. F. W. Krantz.

In technical language, the author discussed the fundamental values of forks, pipes and whistles in the testing of hearing, as contrasted with the new electrical apparatus based on the vacuum tube. He discussed the physics of the latter in great detail, particularly with reference to changes in tone frequency and intensity. The rest of the article was concerned with the demonstration of his own instrument and presentation of charts regarding tests made with it. He concluded with the discussion of a normal range of conversation, showing that elimination of frequencies above 3,000 and below 200 would not seriously impair ability to understand ordinary conversation.

Microscopic Study of Excised Tonsil in Relation to Tonsillectomy. Presented by Dr. Sidney Israel.

The object of this work was to study the existence of a real capsule, the question of muscle removal at the time of operation, the effect of the latter on the end-result, and the question of a bloodless tonsillectomy. One hundred and seventy-two tonsils examined microscopically were removed by experts in seven different ways. The conclusions reached were: 1, that there is no real tonsillar capsule comparable to that of the kidney; 2, that the vast majority of the tonsils show some muscle attached, usually anterior pillar, especially if the tonsil is small. The presence of muscle is the result of lack of a capsule, size of the tonsil and incomplete protection by the instrument. If the tonsils were incompletely removed then they usually showed no attached muscle and vice versa. Damage to the muscle results in deformity in the fossa and in granulations which may become infected.

The question of bleeding is largely a matter of anatomy, not technic. Some patients will bleed more than others, no matter what the method of removal.

The article was illustrated by charts of the various methods used in removal, with statistics for each.

Simulated Mastoiditis Relieved by Sphenoidectomy. Presented by Dr. H. W. Lyman.

The author gave an account of pain in the region of the mastoid, relieved by cocainization of Meckel's ganglion. In several cases, however, this has failed and relief has come only from a more or less complete spheno-ethmoidal exenteration. In one of these, the mastoid had been opened eight times without relief. In all the cases which were among soldiers, there was a marked psychoneurotic element, but they demonstrated that certain forms of spheno-ethmoidal pathology has pain in the mastoid as its most characteristic sign, probably through involvement of the Vidian nerve.

USE OF ACRIVIOLET IN INFECTIONS OF UPPER RESPIRATORY TRACT. Presented by DR. J. H. ABRAHAMS.

The author described the value of acriviolet in numerous conditions, beginning with furunculosis of the skin, nose and auricle, application being made locally in 1:250 dilution. In similar manner it is useful in septal abscess and in sinusitis by direct injection into the affected sinus. It has a marked bactericidal effect in a short time, and is useful in postoperative nasal packing. It can be used in eczema of the canal, in acute otitis media after incision both on the wick and as drops. In chronic ear trouble, it is applied by means of a middle ear syringe with good effect. Mastoid wounds can be packed with gauze saturated in the dye. It is used as a spray and gargle in acute tonsillitis, intratracheally in tracheitis, and in acute nasopharyngitis in children with adenitis. It has been found efficacious in Vincent's angina. Its great disadvantage is its staining, which can be partially prevented by use of vaseline on the exposed skin.

DISCUSSION

PROFESSOR CHURCHMAN said acriviolet is a combined dye that effects both gram-positive and gram-negative organisms. Its use originated in the war and is facilitated by an alkaline medium.

DR. ABRAHAMS (closing): The drug is prepared by dissolving tablets in water.

TECHNIC OF PANSINUSITIS OPERATION WHICH HAS GIVEN THE BEST RESULTS. Presented by DR. R. C. LYNCH.

The radical pansinusitis operation is a last resort in cases in which other measures have failed. Most patients have had a variety of previous operations. The sinus mucous membrane is poorly nourished and prone to degeneration, losing all normal characteristics after infection over a long period of time. Such diseased membrane never returns to normal under conservative treatment once chronic pus formation ensues. There is very little bone change, so that total removal of diseased membrane is the best treatment.

The author first performs a Caldwell-Luc operation, together with a middle turbinectomy and partial ethmoid removal through the antrum. As soon as healing is under way, the external skin is carefully prepared and a short Killian incision made through the unshaved brow. The periosteum is elevated only from the lower half of the incision and stripped back well into the orbit. The common sinus orbit wall is removed and all mucous membrane of the frontal sinus curetted out. Iodin packing is placed in the sinus, the orbital periosteum is retracted outward and the nasal process of the maxilla, nasal bone, lachrymal bone and lamina papyracea removed. The upper ethmoidal cells are cleaned out with a nasal probe as a guide. The sphenoid is next thoroughly curetted and the raw surface sponged with iodin. A rubber drainage tube is brought from the frontal sinus down and out through the nose, and the rest of the cavity is packed with iodoform gauze soaked in benzene. Closure is in two layers, chromic catgut and clips. No external drain, but careful toilet of the eye is made. The after-care consists in removal of the gauze in one day and the drain in three, skin clips on the fifth day. Sounds are passed for two days. The author then mentioned the excellent results which this method has given him.

APPEARANCE AND BEHAVIOR OF THE NORMAL TYMPANIC MEMBRANE. Presented by DR. G. W. MACKENZIE.

The author, after outlining his reasons for presenting an anatomic study of the ear drum, gave a detailed account of its anatomy as generally accepted by older authors, together with his own views on certain muted points. Chief of these was the manner of attachment of the drum to the malleolar handle,

the author believing that the posterior border of the hammer is free from the drum and leaves a triangular space between the two. This point is illustrated by several of the thirty-eight cuts, which serve greatly to clarify the article.

The relations of the several quadrants of the drum and the folds dividing them are next described, together with the surface markings and associated landmarks. A detailed account of the structure of the pars tensa and its component parts is given, including the radial and circular fibers.

The blood supply was shown to be derived from the external canal, which carries vessels from the deep auricular artery down over, but not behind, as is commonly taught, the malleus. Other vessels come from the middle ear mucosa, and the venous return is via the same channels with anastomosis in the membrana propria.

The declinations of the drum were next shown to be largely a matter of the shape and conformity of the external canal, aside from its independent funnel shape. The importance of the relationship of the canal wall and drum in mastoiditis was stressed. There was a further discussion of the posterior malleolar space and its clinical importance, as shown by otoscopic examination.

The author listed the normal characteristics of the drum as intactness, brilliancy, translucency, relationship of the four quadrants, and mobility to Siegle and Politzer inflation. He discussed each of these and the effects of pathology on them.

DISCUSSION

Dr. R. P. Scholtz complimented Dr. MacKenzie on his work, and suggested that the space behind the malleus bear his name.

Dr. MacKenzie (closing) again emphasized the importance of the malleolar relations of the drum in clinical pathology, particularly in the presence of middle ear fluid.

Cicatricial Stenosis of the Esophagus with New Method of Cure. Presented by Dr. Gabriel Tucker.

The author discussed the etiology of esophageal stricture, the location and multiplicity of the lesions and their appearance as seen by examination with the esophagoscope. The dangers of blind examination and bouginage were strongly emphasized, as well as the great advantage accruing from early gastrostomy and putting the esophagus at rest. The various common methods of treatment were discussed, including the use of olive bougies on a swallowed string, the operations of internal and external esophagotomy and string sawing. Retrograde methods of dilatation are mentioned, together with Jackson's method of direct vision bouginage in absence of a gastrostomy opening.

The author then described his method of dilatation by the use of tapering rubber bougies, drawn up through the gastrostomy opening on an endless swallowed string, retained in place while the child is being fed through the gastrostomy tube. This method is absolutely safe, entails relatively little discomfort to the patient and can be continued over a long period of time without harm.

Details of the treatment of twenty-five cases were included in the article, showing the excellent result of this method of dilatation.

Infections of the Tongue and Floor of the Mouth. Presented by Dr. T. E. Carmody.

The author mentioned the existing confusion as to the true nature of so-called Vincent's angina, and its similarity to other less severe infections of the sublingual region. He thought that most cases arose from an infected tooth socket. The clinical appearance was described, the striking point being the absence of fluctuation, the affected region being characterized by boardlike hardness, unrelieved by hot applications. The salivary glands may become involved and osteomyelitis of the jaw may play a part at times. The strepto-

coccus is the usual infecting organism. The severity of the symptoms arises either from extreme toxicity or a secondary respiratory embarrassment, necessitating tracheotomy and often resulting in pneumonia, with a high mortality.

RELATION OF TEETH TO PATHOLOGY OF MAXILLARY SINUS. Presented by DR. LOUIS E. BROWN.

The author pointed out the need of great cooperation between the rhinologist and the dental surgeon in work on the antrum. He described the anatomic relations of the antrum, mentioned its important place as a focus of infection, direct or indirect, and showed how important a part the teeth, both molar and others, play in this connection. Much later antral pathology lies in maldevelopment of childhood, either from improper nursing or congenital defects. The author described his own thorough routine examination to determine antral pathology, including inspection with the nasopharyngoscope. The question of treatment is left open but extraction of a tooth for alveolar drainage is condemned, as liable to produce a permanent fistula. The essential treatment is complete removal of diseased mucous membrane and adequate intranasal drainage.

TREATMENT OF TUBERCULOUS LARYNGITIS BY USE OF CHAULMOOGRA OIL. Presented by DR. CLAUDE LARUE.

The author described the difficulties in diagnosis and treatment of this condition as arising first from failure to see the patient early enough, second, from lack of interest on the part of laryngologists who do not see any large number of patients. The idea that the disease is incurable is erroneous, though present in 25 per cent. of all cases of pulmonary tuberculosis. The author reviewed the history of the treatment of this condition, mentioning the numerous therapeutic remedies for which claims have been made, and gave an account of the experimental work done with chaulmoogra oil. He quoted the experiences of various authors who have used it successfully, but who do not claim a cure in every case. The objection that its use may harm the lung has weight experimentally but not clinically. The oil has even been used intravenously with good effect on the larynx.

The author has divided his own twenty-five cases according to the stage of pathology, as: (1) hyperemic; (2) infiltrative, and (3) necrotic. The use of the oil gives the best results in Group 1, combined as it should be in all forms of treatment with complete vocal rest. Any laryngeal lesion in a tuberculous patient is tubercular till proved otherwise, and should be treated as such. A group of case histories of more advanced cases, together with reports from other men who have been using the oil in these cases are appended. Some are optimistic, others feel less favorable toward the drug. It would appear to have a distinct place in the treatment of this condition, but as yet cannot be said to be the last word.

HISTORY OF THE SINUSES. Presented by DR. R. H. SKILLERN.

The author traced the development of treatment and surgery of sinus disease from the days of Hippocrates down through the ages, mentioning the contributions of a long line of famous names such as Zuckerkandl, Gruenwald, Hajek and Killian. He touched on the influence of England and elaborated on the work of the American pioneers, most of them members of the Triological Society. The individual researches of such men as Mosher, Coffin, Loeb and Onodi were described, together with general accounts of the gradual development of new methods of treatment and original operative procedures. Some account was given of general therapeutic measures, such as vaccines, and the broader relations to ophthalmology was touched on. The whole was a comprehensive summary of the development and progress along this branch of the specialty.

HISTORY OF THE TONSIL OPERATION. Presented by DR. G. L. RICHARDS.

The author traced the development of the operation from earliest historic times to the present, relating the various phases through which it has gone and mentioning the names of those who have been most instrumental in its perfection. The article included the first account of tonsillectomy, its evolution to the present type of operation, the development of the focal infection theory as applied to the tonsil, and nonsurgical methods of treatment. It also contained reference to the more important literary contributions to this subject by members of the Society.

HISTORICAL SKETCH OF DIRECT AND INDIRECT LARYNGOSCOPY. Presented by DR. PERRY GOLDSMITH.

The author traced the history of this branch of otolaryngology from 1743, when a mirror was first used to reflect light in the throat, down through the various epochs, when contributions were made in the advance of science by numerous men to the present day. The first indirect laryngeal examination was made in 1829, following which Garcia and Czermak developed this art to a practical degree. Modelled after instruments used in the bladder, electrically lighted tubes were evolved, and were put to practical uses in the removal of foreign bodies by such men as Green and Gross. The monumental contributions to this line of work by Killian and Bruennings was especially mentioned, together with the brilliant efforts of Jackson and Mosher. Laryngeal photography was touched on, and the suspension technic of Lynch. Mention was also made of a variety of advances wrought by many members of the Society.

UNSOLVED PROBLEMS OF OTOLARYNGOLOGY. Presented by DR. H. P. MOSHER.

In a stimulating review of the unsolved problems of otolaryngology, the author considered chief among these chronic deafness and meningitis, discussing under the latter head the newer operation for drainage of the meninges, and serum treatment. The true answer to the question of focal infection, the selectivity of infecting bacteria and toxicity of various secretions is still unanswered.

In laryngology, atrophic rhinitis and the common cold are still a puzzle, hay-fever and asthma need more investigation, and malignant disease of the nose and throat offers a wide field for surgical research. Particularly do cancer of the larynx and esophagus demand attention, the latter especially being a constant challenge to ambitious investigators. The field of bronchoscopy may become wider, and other benign conditions of the esophagus need further work. Thyroid disease and its relation to laryngeal surgery, as carried out by Frazier, is a newer field. The question of status lymphaticus and the roentgen-ray treatment of hypertrophied lymphoid tissue is still open. Retrobulbar neuritis, Meckel's ganglion, lung abscess, all are capable of being more thoroughly investigated by a larger group of men, who must, however, have a broad point of view and the essential requirements for the pursuit of research work.

LYMAN RICHARDS, M.D., Secretary.

Book Review

TRAITEMENT CHIRUGICAL DE LA DILATATION BRONCHIQUE. By P. GUIBAL (de Béziers), Hospital of Paris. Paper binding, Price: 10 fr. Pp. 169 with 31 illustrations. Paris: Masson et Cie, 1924.

The text is written in a clear, concise form and the author goes directly to the point, not wasting any unnecessary words. With a brief introduction of the subject, he divides the disease into two general divisions: (1) bronchiectasis of the infant and; (2) of the adult.

The end-result without surgical intervention is fatal sooner or later, therefore the prognosis is bad. The mortality of the operation, even though it is high, is justifiable. In infants, medical treatment is always resorted to while in adults the treatment is always surgical.

The differential diagnosis is not always easy but the roentgen-ray examination of the lungs, after introduction of lipiodol, i. e., iodized oil, almost invariably makes the diagnosis clear.

The author describes the four varieties of operative procedure in various types of cases:

1. Compression of lung.
   - (*a*) Artificial pneumothorax.
   - (*b*) Loosening up of the parietal pleura.
   - (*c*) Direct compression of lung.
   - (*d*) Thoracoplasty, extra pleural.
2. Drainage of the bronchial cavities (pneumonotomy).
3. Operation causing atrophy of the lung by ligated vessels at the hilum.
4. Resection of the lobe involved (lobectomy). He then describes the various forms, clinical as well as anatomic, in which the before mentioned surgical procedures are indicated.

The surgical technic in all these procedures are given clearly and concisely and some are illustrated with drawings. Four of the author's own cases are cited, three ending fatally; the fourth patient, in whom lobectomy was performed, recovered completely.

His conclusions are as follows: Chronic bronchiectasis is practically fatal. It is incurable by medicinal treatment. Unilateral diffuse patients can be operated on by extrapleural thoracoplasty. Artificial pneumothorax is useful in infants and in adults in the beginning of the disease. Pneumonotomy is indicated where the pockets are large and numerous. Bronchiectasis, limited to the superior lobe, must be treated by loosening of the parietal pleura with permanent compression of the lung. The bronchiectasis of the inferior lobe justifies lobectomy, the only procedure in which a cure can be effected. The mortality is from 40 to 50 per cent.

Note: Evidently the author has ignored, either intentionally or otherwise, the splendid work of American bronchostomists (Jackson, Yankauer and others) in treating bronchiectasis by direct bronchoscopy. They employ suction, lavage, and so forth, and their reports are often encouraging, as a great many of their patients are cured and most of them grateful for relief.